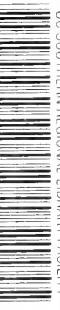


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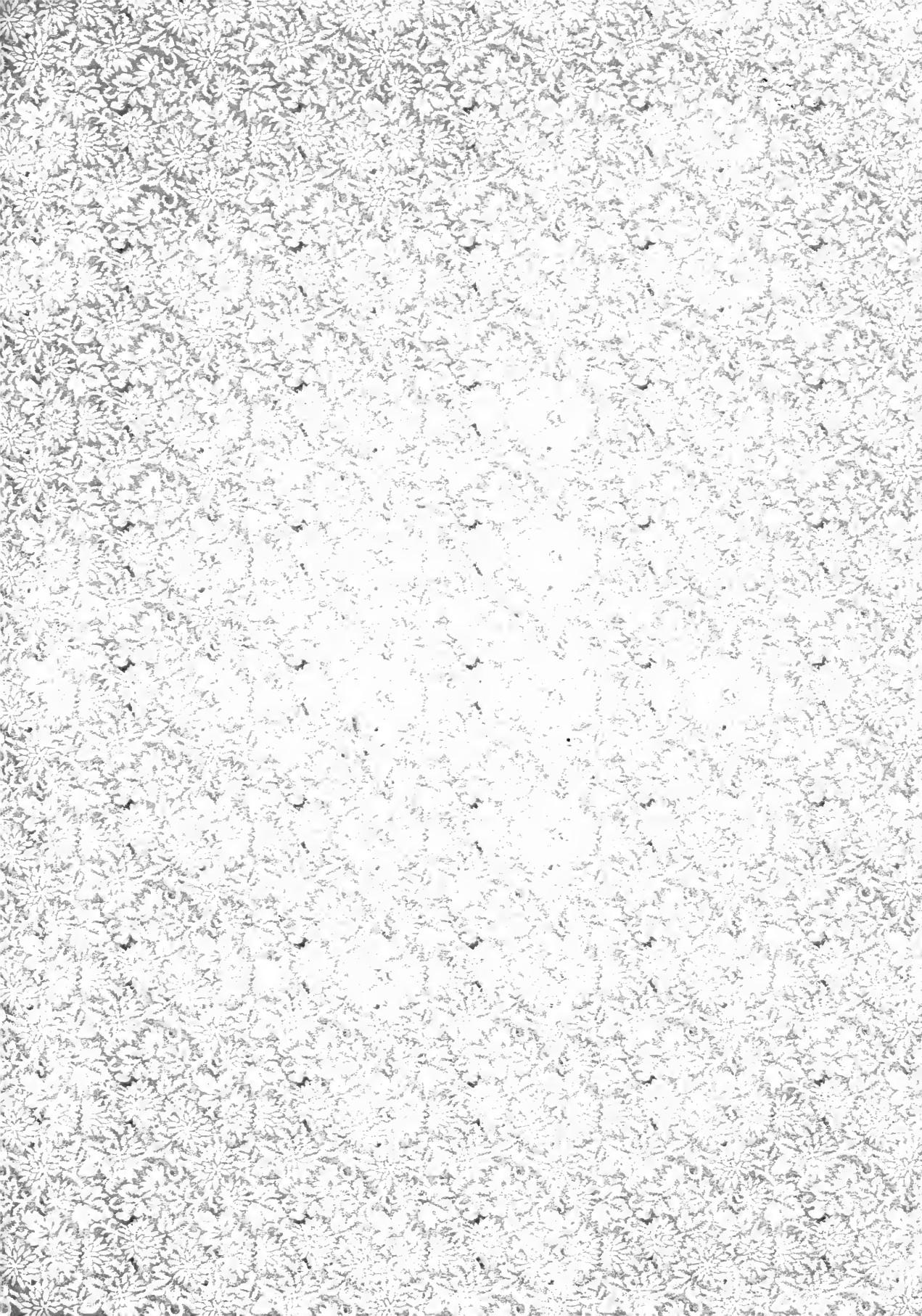
WARRINGTON'S ROMAN REMAINS.



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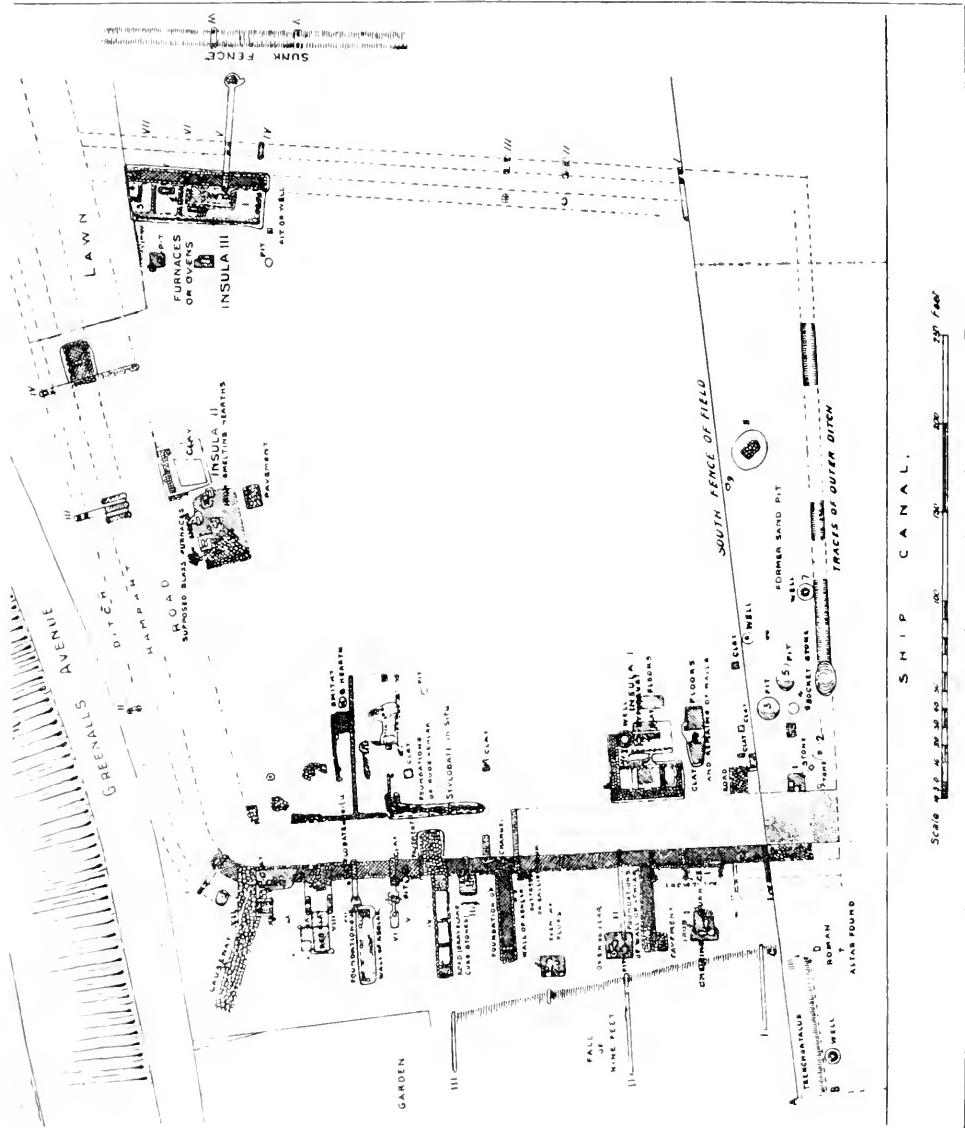


F.M. Heinkelheim
March 1957

PLAN OF ROMAN OPPIDUM,

DISCOVERED AT WILDERSPOOL, 1898, BY THOS. MAY, F.R.I., F.S.A., SCOT.

GENERAL PLAN I.



WARRINGTON'S ROMAN REMAINS.

THE ROMAN FORTIFICATIONS, POTTERS' KILNS, IRON AND
GLASS FURNACES, AND BRONZE FOUNDERS'
AND ENAMELLERS' WORKSHOP

DISCOVERED AT WILDERSPOOL AND STOCKTON HEATH,
NEAR WARRINGTON,

BY

THOMAS MAY, F.E.I., F.S.A.Scot.

WARRINGTON:

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P R E F A C E.

THIS publication describes the results of eight years of observation and collection, and five years of systematic exploration on the site of the Roman Oppidum discovered by the writer in 1898. The excavations were initiated by a grant of £10 from the Historic Society of Lancashire and Cheshire, and continued by private subscriptions and grants from the Museum Committee of the Warrington Corporation. The cost of a large number of analyses of ores, slag, bronze, glass, waste, &c., has been defrayed by the same Committee, and the analyses have been partly done gratuitously by Mr. Andrew Harley, analyst, Coalbrookdale Iron Co., and Mr. F. G. Ruddock, F.I.C., public analyst, Warrington.

Subscriptions for the Excavation Fund have also been received from the following gentlemen :—

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CONTENTS.

	PAGES.
I.—Introduction and general summary—Great military highway running north and south—Branch roads or streets—Eastward and westward extensions of the main <i>Via</i>	1—3
II.—Remains of rampart, berme, and ditch—Angle tower—Ballistaria—Materials of the superstructures—Gateways—Iron pivot rings... 	4—9
III.—Fortified annexes on west side of oppidum—Building materials—Long corridor house—Hypocausts or suspensurae of massive boulder-clay (terra-cotta)—Secondary use of building as smithy 	10—14
IV.—Construction of dwellings—Huts or sheds for slaves and workshops—Clay and iron sling balls for firing thatched roofs—Local building materials...	15—17
V.—Iron smelting—Hand bloomeries—Base of an iron smelting furnace I. for continuous working—Mineral coal, iron ore, and slag found adjoining—Analyses of ores, slag, and clay wall of furnace—Objects found in surrounding soil—Iron smelting hearth II.—Analyses of soft iron and slag	18—24
VI.—Smithy or refining furnace I.—Finds in its vicinity—Analyses of cast and wrought iron and cinder—Refining furnaces II. and III.—Ore roasting ovens I., II., III.—Analysis of slag—Finds in their vicinity—Early methods of iron smelting 	25—30
VII.—Ore-roasting ovens uncovered at Stockton Heath, Cheshire, in 1903—Foundations of a large dwelling or workshop—Coins and various other objects 	31—33
VIII.—Iron smelting floor with crucibles—Bronze, slag, large ore-pounding stone mortar and other finds... 	34—36
IX.—The earliest glass makers' furnaces in Britain—Ancient Roman and modern (Venetian and local) glass-making—Glass makers' workshop I.—Oven for calcining flints—Specimens of sandiver, crude glass (massae), window glass, glass vessels, twisted rods, and other objects from surrounding soil 	37—39

CONTENTS.

	PAGES
X.—Glass makers' workshop II.—Annealing ovens or lires—Cut glass fragments —Analysis of sandiver or scum—Fragment of glass melting-pot described by Mr. J. Paul Rylands, F.S.A.	40—44
XI.—Glass makers' workshop III.—Furnaces or lires 5, 6, 7, and 8—Large bead and other glass specimens from vicinity—Coins and other finds...	45—49
XII.—Glass makers' workshop IV.—Paved courtyard, clay floors, and furnaces —Glass makers' workshop V.—Coins and other finds—Analyses of sandiver and contents of clay melting pot—Various glass-paste specimens	50—58
XIII.—Three potters' kilns—Potters' waste—Denarius of Antoninus Pius—Pivot-stone of potters' wheel	54—58
XIV.—Local ware—Local potters' names—Castor ware—Samian ware—List of 130 potters' names and graffiti found locally	59—64
XV.—Supposed temple or shrine of Minerva—Stone head of goddess—Diminutive bronze bust of goddess—Objects in bronze, iron, lead, glass, and polished flint celt of Cissbury type	65—66
XVI.—Stone head of goddess described—Local worship of Minerva probable—List of altars and temples of Minerva in Britain—Roman altar found at Wilderspool in 1896	67—70
XVII.—Bronze founders' and enamellers' workshop uncovered at Wilderspool in 1902—Coins, enamels, bronze crucibles, crude enamel, iron three-bladed arrow-head, glass and lead, Samian ware urns and cups found in vicinity—Analyses of brass (orichalcum) and slags—List of localities in which mineral coal was used during Romano-British period—Villa d'Anthée, near to Namur, Belgium, compared	71—78
XVIII.—Various objects, bronze foot-rule, fibulae, ligula, querns, and animal remains described—Complete list of coins	79—83
XIX.—General conclusions—Date of foundation and destruction of oppidum—Various instances of the use of clay—Conclusion	84—87

WARRINGTON'S ROMAN REMAINS.

I.—GENERAL SUMMARY.

THE Romano-British fortification with its adjoining suburb recently discovered on the south side of the river Mersey near Warrington, and now for the first time fully described, originally extended continuously for nearly quarter of a mile from the river bank through the townships of Wilderspool and Stockton Heath, the site being formerly known as the Town Field. These townships are still historically and ecclesiastically in the county of Chester, though the Manchester Ship Canal, which became the southern boundary of the borough of Warrington by an Order in Council dated 9th November, 1896, now divides the site into two parts and includes the Wilderspool portion for Local Government purposes within the latter and in the county of Lancaster.

The whole area is included on sheet XVI. of the 6-inch ordnance map for Cheshire, but of the trapezoidal enclosure of about nine acres marked ROMAN STATION on the old ordnance maps no evidence exists.

Everything known and recorded on the subject previous to the commencement of systematic excavations under my direction at the end of 1895 is summarised in W. Thompson Watkin's "Roman Cheshire," pp. 260-273, published in 1886; and the portable objects previously discovered are fully described in Dr. Kendrick's "Guide to the Roman Remains in Warrington Museum."

By its original inhabitants the oppidum is supposed to have been called Veratinum, an unappropriated name following Deva Victrix (Chester) in the list of Romano-British "civitates" made by the Geographer of Ravenna,

but there is no direct evidence for such appropriation.*

The traces of Roman occupation explored in this locality since 1895 include, (1) a great military highway running north and south beneath the surface of the cultivated fields on the west of the present thoroughfare over the swing bridge at Wilderspool, and branching eastward and westward along the south bank of the river Mersey close to Greenall's-avenue (Old Chester-road); (2) the foundations of a great rampart, partly uprooted on the south and east, but originally four-sided and enclosing an area of about three acres inside the paddock adjoining Messrs. Greenall, Whitley and Company's brewery at Wilderspool; (3) a small external fossa or ditch surrounding the latter, of the V-shaped type, and probably intended for marking out the ground of the original fortification, rather than for defensive purposes; (4) two or more fortified external enclosures or annexes, with walls abutting on the western rampart; (5) foundations of dwellings or work-shops inside and outside the fortification; (6) two ore smelting and two iron fining or crucible furnaces in the Wilderspool brewery field, and an iron smelting hearth in Mr. C. W. Davenport's sand-pit at Stockton Heath (this part of the ground being excavated by his kind permission); (7) eight or more glassmakers' double furnaces or

* The term "civitas" applied to the Wilderspool remains is objected to as misleading by our principal authority, Mr. F. Haverfield, F.S.A., who only consents to "oppidum" as less misleading, being used by Caesar in a technical sense. But "urbs" or "ricus" appear still more misleading as applied to a partly fortified industrial town extending over quarter of a mile on both sides of the Roman highway.

WARRINGTON'S ROMAN REMAINS.

fires and four reverberatory furnaces for melting bronze, &c.; (8) bronze founder's and enameller's or jeweller's workshops beside the front lawn of Wilderspool House; (9) a series of floors, hearths, ovens or circular furnaces for heating caldrons, of massive boulder clay, more than fifty in number, on both sides of the Roman highway for quarter of a mile between the river and Stockton Heath (a great portion of the oppidum having also been swept away by the cutting of the Ship Canal between the autumn of 1887 and 1st January, 1891, without archaeological result, and another portion being still unexplored beneath two cultivated fields in Stockton Heath); (10) the base of a shrine or laige public altar for burnt offerings on which lay the head of a Roman goddess carved in stone; (11) three potter's kilns and traces of others in a private garden at the end of Dun-donald-avenue, Stockton Heath, on land belonging to Mr. John Hallows, who has also done the principal share of photographing and excavating; (12) the foundations of a large building on land leased for building purposes by Mr. W. Boothroyd, and excavated by his consent.

There have also been a large number of small "finds," now deposited in the Museum, in the shape of coins and other objects in bronze, iron and lead; many fragments of glass and pottery, and whole vessels of Samian, and common soft unglazed black, grey, and red wares; beads; crude glass, glass waste, iron slag and ore, cannel and ordinary coal, fragments of crucibles containing bronze, polishing stones, hones, socket stones, two large stone mortars, one or two carved building stones, numerous querns, and a Roman altar, &c., collected since 1895.

These have already been partly described in my reports printed in the Transactions of the Historic Society of Lancashire and Cheshire, vols. 12, 14, 16, but as these reports are highly technical and necessarily disjointed owing to the slow progress of the work, the following papers giving a more popular account of the results of these excavations, initiated by the Historic Society just mentioned in 1898 and continued partly by private subscription, but chiefly by grants of the Museum Committee of the Warrington Corporation, under my direction, have been prepared. (See Frontispiece.)

THE GREAT MILITARY HIGHWAY OR VIA. This is the best known and most strongly marked and enduring feature in connection with the Roman settlement since it has been traced and recorded by various writers as running north and south between Kinder-ton (Condiate) and Northwich (Salinae) on the one hand, and Wigan (Coccium) on the other, and as consisting of a foundation of sandstone rubble with a layer of gravel upon the top, varying from 15ft. up to as many yards wide, in most places hidden by one or two feet of soil and only revealed by ploughing or digging. Speaking generally, it follows nearly the same line as the present highway between Warrington and Northwich by Stretton and Great Budworth, and is shown by dotted lines on the old ordnance maps. As it approaches the river Mersey from the south, it diverges slightly westward from the crossing in order to enter the oppidum, and, along with the ruins of the great rampart, forms a distinct ridge or agger along the west side of the Wilderspool brewery field. It can be seen distinctly in cross section from the banks of the Ship Canal and is marked by a row of large trees on one side and a plantation of small ones on the other.

At present there is also a longitudinal section of the same road 66 yards long, consisting of a mass three to four feet thick of gravel and sandstone blocks, exposed at the upper end of the new street off Ellesmere-road, Stockton Heath, marked by the appropriate name of "Roman-road."

This extraordinary construction, which will be frequently referred to in these papers as the Via, has been uncovered in a back street newly laid down by Mr. William Twiss, off Kimberley-drive, Stockton Heath; also at the top of "Roman-road"; and several times in the Wilderspool brewery field, and found to average 25ft. in width, with extensions in one or two places, in the shape of gravel footpaths about three feet wide. On the north side of the Ship Canal its thickness, along with the ruins on the top, is over four feet, but its eastward extension in the same field, which has been traced for a distance of 300 yards along the bank of the river, pointing in the direction of an old road called Lousher's-lane and leading to the ancient ford

WARRINGTON'S ROMAN REMAINS.

at Latchford, though of equal width, was found to be merely a layer of gravel two or three inches thick without the usual bedding of sandstone rubble.

BRANCH ROADS OR STREETS. Several paved causeways were met with, branching from the main Via during the recent excavations. Commencing at the south there is a boulder-stone pavement three yards wide, now partly uncovered on the west side of the Via, at the top end of "Roman-road," close to the foundations of a great house or edifice which are being excavated; a little further north, on the same side of "Roman-road," the workmen of the Bridgewater Trustees, when making the new street, exposed a layer of rubble 15 $\frac{1}{2}$ ft. wide for a distance of 11 ft. at a depth of four feet below the grass, which may be the commencement of an early and superseded roadway leading westward to Chester. Just on the opposite side of the Via and at the same level as the latter (one foot three inches below the grass) there was a pavement of rubble three yards wide and 17 ft. in length pointing in a north-east direction. About ten yards further north on the same side there was a cobble-stone causeway at an equal depth below the surface, 13 feet wide, which was traced for a distance of ten yards. The finding of four instances of urn burial on either side (the urns being preserved whole and deposited in the Museum along with the burnt bones) proves it to have been an ancient Roman causeway, such localities being usually chosen for cemeteries.

Coming now to the fortified area on the north or Wielderspool side of the Ship Canal, the paved ways, which may properly be called streets, met with were the following:—On the east side of the Via a few feet inside the south fence of the brewery field there was a short piece of rubble pitching, ten feet wide by 15 feet in length, pointing in an eastward direc-

tion. On the opposite side of the Via, about the middle of the western rampart, there is a narrow paved street or alley running for a distance of 20 yards westward where it suddenly breaks off near to the brink of an old sand pit, the digging of which has produced a fall in the ground of nine feet, and removed every trace of Roman occupation that ever existed beyond. It consists of a few inches of gravel bordered by rude kerbstones nine feet across, at a depth of about a foot below the sod.

On the same side of the Via, close to the north-west angle of the field and fortification, there is a rubble pavement with only a small portion remaining of gravel upon its surface, 8 to 11 feet wide, which extends along what was once the sloping bank of the river for a distance of 85 feet. Two buttresses were found on its steep or north side, composed of stones set on edge in several steps to a considerable depth in the sand, to keep it from slipping down the bank. An extension of the same roadway was cut through and measured in making a culvert for the main drain in June and July, 1897, at three and a half feet below the present surface of Greenall's-avenue (Old Chester-road) 330 yards from the north-west angle of the fortification. It was found to be the usual foundation of rubble covered with ferruginous gravel, forming a hard pan and excellent surface for travelling.

From the eastern extension of the Via there were two narrow layers of sandstone rubble five and seven feet wide respectively, which branched off at right angles in a direct line northward, on either side of a water conduit or drain. The one along the west side of the latter was 39 feet and that on the east side 50 feet in length. Whether they were causeways leading to the jewellers' workshops or foundations of rude walls or simply pitching to prevent the soft surface from being trampled into the ditch, it was hard to determine.

WARRINGTON'S ROMAN REMAINS.

II.

RAMPART, BERME AND DITCH. Until quite recently it was customary to speak of these remains as a Roman camp. But the only indication of a military occupation discovered during the excavations has been a fragment of thick red tile or thin brick bearing a portion of an inscription with the letters X X D, faintly stamped, supposed to refer to the famous 20th Legion Devensis, but with the usual epithet V.V. (Valerian Victorious), found on all other inscriptions of the legion, omitted. If so it is an indication that the

original fortification was erected by a detachment of that legion which came over to this country from Germania Inferior during the reign of Claudius in A.D. 43, and was for nearly 300 years in garrison at Chester, which is very likely to be the case. Since prolonged searching has yielded no other distinctive traces of a camp but abundant remains of a civil population engaged in various industries, whatever it may have been originally, the existing remains are those of a walled town, which may more appropriately be called an oppidum. The mere existence



OUTER FACING STONES OF WESTERN RAMPART AT WILDERSPOOL.

WARRINGTON'S ROMAN REMAINS.

of a wall or rampart does not prove it to have been a camp, since no community could exist in those days without a fortification, and the Wilderspool remains most nearly resemble those of the Roman town of Uriconium, at Wroxeter, only 50 miles south in a direct line.

WEST SIDE. The principal remains of

the fortification are on the west side, along the outer or western margin of the great Via, on the west side of the Wilderspool brewery field, bordering the plantation. Though now covered by about a foot of soil, here may still be traced, by means of digging, a more or less continuous platform nine feet wide and one to two feet deep, composed of ashlar and rubble of the local red sandstone, and extending



1. WELL AND BASE OF WOODEN PILLAR.
2. QUERN.
3. FOOTINGS OF RAMPART, N.-W. ANGLE, AT WILDERSPOOL.

WARRINGTON'S ROMAN REMAINS.

from fence to fence of the field, all but a few feet at the north end, close to Greenall's-avenue, a distance of nearly 100 yards. The outer facing stones are in position for about a third of the distance (90 feet), commencing at 53 $\frac{1}{2}$ feet from the south fence; they are in two courses and bonded for a distance of 15 feet, those of the lower course averaging one foot four inches in length by nine inches in depth and breadth, and those of the upper 11 inches by six inches (depth and breadth); from this point they form a single layer of larger dimensions, up to two feet two inches in length by nine to 14 inches in depth and breadth. The facing stones are much larger for a distance of 27 feet near to the north-west angle, but are tumbled and out of position. A bronze regula or pes (folding foot-rule) was found under one of them.

Opposite them along the inner side of the rampart (on the edge of the Via) there were facing stones of smaller size, 11 inches square by six inches deep, the space between the two marginal rows being packed with a nine-inch layer of hard boulder-clay, and the width between their outer edges being nine feet, which is the average width of the stone platform or foundation of the rampart on this side. Along the inside for the rest of the distance the facing stones were in many places wanting.

NORTH SIDE. The foundations of the northern rampart are much less complete. They have been cut through and cleared away for more than 33 yards in making an entrance to the field from Greenall's-avenue (Old Chester-road), near to the west end; and from this point the looseness of



OUTER FACING STONES OF FOUNDATION OF RAMPART
(NORTH SIDE) AT WILDERSPOOL.

WARRINGTON'S ROMAN REMAINS.

the soil caused by recent disturbance shows that larger stones have been removed where they were easily accessible along the public highway. They were traced only for a distance of 24 feet near to the lawn fence of Widderspool House, where excavation necessarily ceased. Here the width was about 12 feet and the stones in three or four courses, but of small dimensions and very irregular.

EAST SIDE. On this side the foundations of the rampart were traced for a distance of $7\frac{1}{2}$ feet, commencing at the south fence of the same lawn, and found to be merely a layer of rubble nine to ten feet wide, without squared facing stones. Search for the foundations was made by means of trenches in the same direction beyond this, but only slight traces in the shape of patches of rubble and a layer of clay were met with. Towards the south side of the field, where was once a garden or shrubbery, they appear to have been entirely eradicated.

SOUTH SIDE. For several years—1895-6-7-8—previous to the commencement of systematic excavation, observations were made on this portion during the excavation of a sand-pit along the north bank of the Ship Canal, by kind permission of the owner, Mr. Frank Warburton, and among other things discovered was the Roman altar presented by that gentleman to the museum. The principal indication of the existence of the rampart was a confused mass of stones and clay over-lying the natural bed of pure sand of glacial origin (the middle sands of the local drift beds) forming the subsoil. The line of the outer ditch (to be presently described) was here fortunately observed and carefully noted, and was the only certain indication of the position of the rampart on this side.

In a large number of cross sections a V-shaped ditch, six to eight feet in width and two and a half to three feet in depth, at the level of the undisturbed subsoil, was found at an average distance of nine feet from the outer face of the rampart, the intervening space (or berme) being left to prevent the wall from being undermined and falling into the ditch. To these dimensions some addition must be made, probably about a foot, for the depth of surface soil at the period of its construction. Thus they conform roughly to those

of the fossa of the later Imperial or Hyginian encampment, of which the breadth was to be at least five feet and the depth three feet.

AREA. The position of only one of its sides and one angle having been fully determined, it was only possible to estimate the size and shape of the fortification approximately by extending the lines of the outer ditch upon the plan until they met. In this way a trapezium or figure with four unequal sides was formed measuring 454 feet on N., 394 feet on S., 468 feet on E., and 372 feet on W., having a mean length and breadth of 420 feet from N. to S., and 434 feet from E. to W. Deducting 50 feet from these dimensions for the width of wall, berme, or ditch on both sides gives a mean length and breadth for the enclosed area of 370 feet from N. to S., by 374 feet from E. to W., or a little over three acres.

ANGLE TOWER. There were traces of an angle tower, 16 feet square, projecting nine feet, outside the rounded N.W. angle of the rampart, in the shape of large stones deep down in clayey soil at the four corners, but no continuous walling.

BALLISTARIA. Foundations of buttresses or solid rectangular towers built up against the rampart were found on the east and west sides, in the shape of large boulder-stones and blocks of sandstone set in stiff boulder-clay deep down in the ground. That on the west measured 13 feet along the outside face of the rampart by five to seven feet, and was placed near the middle, in the angle of the external wall of an annexe (to be presently described) abutting on the rampart. That on the east consisted of a strong wall of ashlar, two feet six inches thick, running 26 feet parallel to the inside of the rampart, with return walls ten feet in length (outside measurement) abutting upon the latter, the interval between the walls and rampart being filled with very stiff boulder-clay. Its position was 31 feet from the lawn fence, or about one-third of the length of the eastern rampart from its north-east angle.

These solidly constructed enlargements of the rampart and the strengthening core of boulder-clay inserted close to the north-west angle (above-mentioned) were concluded to belong to ballistaria or platforms for supporting the artillery

WARRINGTON'S ROMAN REMAINS.

(ballistae, catapultae, onagri, &c.), for mural defence, owing to their resemblance to those found in other Roman fortifications, where the large roughly rounded stones used as missiles were also met with, at Housesteads (Borcovicus)* and High Rochester (Bremesium), upon or near to the great wall of Hadrian, and at Croy near to one of the sod platforms upon the Antonine wall.†

The character of the superstructure of the rampart and its appearance when complete may be inferred from the remains and from those of other Roman towns. The wall at Wroxeter (Uronicum), three miles in circuit and averaging six feet wide, "consisted merely of large cobble stones (or small boulders), and broken stones from the quarry, which had been placed together without any order, and embedded in clay," . . . "with its sides tolerably smoothed, but with no evidence of facing stones."‡ Stiff boulder-clay was employed in every structure, often alone, at Wilderspool. The width of the foundations, nine feet, and the mass of clay and rubble covering the site show that the interior of the rampart was composed of rubble, earth, and clay, built "anyhow," as at Uronicum, while the rows of facing-stones are evidence that it was coated with an outer shell of masonry, nine to 14 inches thick (the width of the stones) as at Melandra, near Glossop, and at Gellygaer, near Cardiff, &c. The stones of the outer casing appear to have been laid in lime mortar, of which slight traces were found under those of larger dimensions, where it was less accessible to the roots of plants, which often formed a matted covering upon them. They were evidently split with wedges, as they are not tool marked, and a partly worked stone deposited in the Museum to show the mode of working, has a groove worked with a pick along the edge of its rough face for the insertion of wedges, and among the iron objects so deposited there is also one of the wedges. The wide joints between some of these roughly squared blocks are tightly packed with thin flakes of the same kind of red sandstone. They

are laid lengthwise along its axis, and not across the width of the wall, another indication that they are a mere revetting and not belonging to a regularly constructed wall of masonry. In the latter case the stones are invariably tapered and laid lengthwise into the thickness of the wall to afford space for the grouting and a firm hold on the inside, as well as a close joint to prevent the insertion of levers on the outside, the Romans being excellent masons. This outer casing, if carried a few feet above the rampart walk, would form a parapet for protecting the defenders.

The platform or foundation was laid directly upon the natural surface, without bedding or excavation, and the original layer of black peaty sand, nine to twelve inches thick, with "silver sand" beneath, everywhere underlies it.

GATEWAYS. Where a road enters through the rampart there of necessity must have been a gateway. A causeway ten feet wide was described as striking off from the Via on the west side near to the N.W. angle, and search was made on either side for foundations of the gateposts. These were of wood, or the stones had completely disappeared, but there were signs of bedding in squares five feet wide and 15 feet apart descending to a great depth in these positions. A portion of the worn and much oxidised iron ring with which the pivot of one of the wings of the great wooden gate was shod was found near them.

A little further south, at 90 feet from the north fence, there were large blocks of sandstone, two on the outer and one on the inner face of the rampart, in position for supporting jambs or gateposts, the passage between them being only four feet, and there was a fourth still larger block on the inside four feet further apart. If any opening existed, it could only have been for a doorway, as there was no trace of pavement beyond a few feet outside.

There were no traces of gateposts on the sides of the narrow causeway which left the Via at right angles and crossed the western rampart near the middle.

In digging the sand pit where the Via enters from the south two large square sandstone blocks, two feet eight inches wide by eight inches thick,

* Bruce's *Roman Wall*, ed. 1867, p. 31.

† *The Antonine Wall Report of the Glasgow Arch. Soc.*, pp. 52 and 111.

‡ Wright's *Uronicum*, p. 97.

WARRINGTON'S ROMAN REMAINS.

were found bedded on a layer of very stiff clay ten feet square by eight or nine inches thick at a depth of four feet below the grass, in position for supporting the pillar of a gateway. They were set corner to corner, and two stones necessary to complete the square had evidently been abstracted. Close by was the socket-stone broken

in two (now in the Museum), measuring originally 22 inches square by 18 inches thick, having a smoothly worn conical hole from five and a quarter to four inches in diameter for the pivot of the wooden gate. About half of the iron pivot-ring, much worn and corroded, was also found in its vicinity.

WARRINGTON'S ROMAN REMAINS.

III.

FORTIFIED EXTERNAL ANNEXES. These are at the extreme west of the Wilderspool brewery field, outside the principal fortification described in Part II. The remains are those of three parallel walls running from east to west, and abutting on the outer face of the west rampart. They are carried across the external fossa, after it has been filled up, on a 6-inch layer of stiff boulder clay, and have, therefore, been added on subsequently to the erection of the main enclosure. There are no return walls at their outer (western) extremities, where they terminate in ragged edges on the verge of an old sand-pit, and no estimate can be formed of their original dimensions.

Commencing at the south, the first of these foundations strikes off at right angles to the main rampart at 64 feet from the south fence of the brewery field and extends for a distance of 47 feet, consisting of a layer seven feet wide and one foot six inches deep of sandstone blocks and rubble, consolidated with loamy sand, at a depth in some places, of only eight inches below the present surface. The shallowness of the soil at this spot is due to the adjacent sand-pit, which has caused a sudden fall of nine feet in the ground, and cleared away all the Roman remains that ever existed beyond. Having been covered and forgotten, three deep trenches had to be cut down to the bottom of the pit to ascertain the cause of the depression.

At an interval of 73 feet further northward, or 141 feet from the south fence of the field, the second wall extends for a distance of 50 feet and is nine feet wide by two feet six inches deep at two feet below the sod. On both sides the foundations are faced with ashlar, the stones being squared by splitting with wedges, and those on the north side being larger than on the other, showing the latter to belong to the outside, and the wall itself to be on the north side of the annexe.

In the space between these two walls were the

remains of two elongated furnaces or lires surrounded on all sides by clay floors, which were concluded, from their shape and accompaniments, to have been used by flint glass makers, specimens of clear glass (crys-tallum) ornamented with circular incuse facets being found in the body of the clay. These glass makers' furnaces are fully described in Part X.

The foundations of the third wall are at 178 feet further north from the preceding, or 230 feet from the south fence. They are six feet six inches wide and extend 45 feet from the west rampart, but they were found to be much tumbled and difficult to trace owing to the nearness together of the young trees in this part of the plantation. This obstruction, which it was found impossible to overcome, prevented any satisfactory exploration where the remains appeared to be most interesting. Clay floors and furnaces were uncovered on both sides, beyond the trees, and in a rubbish-pit between them and the rampart a number of interesting objects in bronze, fragments of crucibles containing bronze, glass waste, and animal remains (identified by Prof. Boyd Dawkins and to be described subsequently) were discovered.

FOUNDATIONS OF DWELLINGS OR WORKSHOPS. For understanding the character of these, some preliminary remarks are necessary as to the materials of which they are constructed. The Romans were not only skilled masons, but they were expert in adapting any kind of materials that came nearest to hand for building purposes.

In the South they employed flints, chalk, &c., in the North freestone and lime grouting, further north sods or turf, in the West and in our own locality red sandstone and boulder-clay for the construction of walls.

Not only were the Romans much indebted to the local boulder-clay for the comfort and stability of their dwellings, but we also are greatly indebted to the same material for the preserva-

WARRINGTON'S ROMAN REMAINS.

tion of the remains from decay and removal for the sake of the material, &c., and for the preservation of their shape and consequently for our knowledge of their intended purpose.

The local stony clay or boulder-clay is a remarkable feature owing to its purity, hardness, and extent. It comes to the surface over a great portion of the town of Warrington, and underlies the soft alluvial clay forming the bed of the river Mersey at a depth of 18 feet. On the Cheshire side it appears upon the surface at Ackers Pits, quarter of a mile to the west, and it forms a layer one foot six inches thick, under six or eight feet of sand, at Stockton Heath, to the south of the oppidum, upon which the potter's kilns recently uncovered are based.

There is no natural bed of clay, but a deep bed of pure sand forming the sub-soil upon the site of the Roman oppidum, and the presence of clay in such enormous quantities is the result of Roman industry. Many structures such as kilns, ovens, fire-places for caldrons, reverberatory furnaces, lires, hypocausts, &c., have been formed entirely of this material. The trouble of brickmaking was saved by moulding the plastic, well-puddled mass into the required shape, and after natural drying, hardening by means of the ordinary fires of dried wood inside the fire-holes.

Owing to the shallowness of the surface soil, about one foot three inches, covering the remains, only the foundations (or underground courses) of walls have as a rule been found. Walls of dwellings had invariably a bottom course or bedding of stiff, well-puddled brown clay three or four inches thick, exceeding in width the next course of stones above them, thus serving as a "damp-course," against both ascending and descending moisture, sand being a solid foundation when covered from wind and rain.

Clay was the material invariably used for interior floors of both huts and halls. It also formed a large portion of the superstructures, but this is a branch of the subject which can be more satisfactorily dealt with after the remains of ordinary dwellings, which were two in number, have been described.

LONG CORRIDOR HOUSE. The only remains of this description inside the

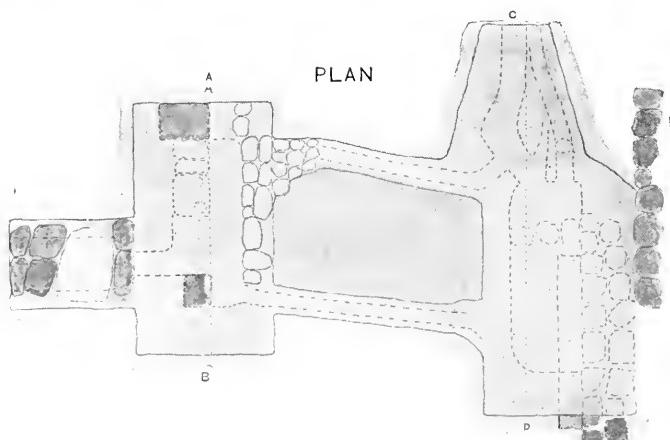
fortified areas are (1) the foundations of two walls nearly parallel (four to seven feet apart) and two feet six inches wide, running from east to west near to the north-west corner of the main enclosure, at 86 $\frac{1}{2}$ feet from the north fence of the field along Greenall's-avenue. The northmost commences at 21 feet from the edge of the west Via and extends 40 feet in an eastward direction. It consists of a 2-inch layer of stiff brown clay overlaid with one or two courses of sand-stone rubble. The southmost and more substantial of the two foundations extends from and at right angles to the Via for a distance of 80 feet, and may still be traced at a depth of one foot ten inches below the grass and 96 feet from the north fence. It is composed of similar materials, but there are two courses of squared facing stones on either side one foot six inches deep above the clay bedding. Of the west or front wall along the edge of the Via there remained only a layer of large unhewn blocks of red sandstone four feet wide and 30 feet six inches in length, its total frontage, including the corridor and north wall, being 42 feet six inches, indicating that the main building on this side was gable-ended.

Prolonged search for return walls at the opposite end and party walls throughout the length of the building resulted in nothing very definite. Along the east and south sides there was no continuous walling, but deeply bedded sandstone blocks and patches of rubble at wide and irregular intervals were inferred to be the foundations of stylobates, or supports for wooden columns, which by their position gave a width of span for the roof and extreme width of the building of 26 to 27 feet over all. A large tree prevented the exploration of the interior at the west end, where there were traces observed of massive clay floors and furnaces or ovens. At the east end merely a few patches of rubble pavement or pitching were uncovered here and there. On the south side, near the middle, at 44 feet from the Via and 12 to 14 feet from the principal north wall, 80 feet long, above described, there was a clay floor which included a novel feature in the construction of a Roman dwelling in the shape of two hollow platforms of burnt clay or terra cotta at either end connected with fire-holes, which were evidently suspensurae or

WARRINGTON'S ROMAN REMAINS.

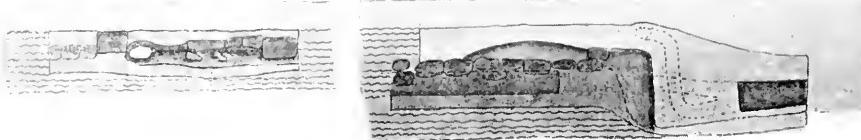


CROSS SECTION OF NO. 1 HYPOCAUST IN LONG CORRIDOR HOUSE AT WILDERSPOOL.



SECTION AT A-B.

SECTION AT C-D.



WARRINGTON'S ROMAN REMAINS.

hypocausts for warming the apartment. They were placed lengthwise across either end of the latter, their surface being level with that of the floor, which was a layer of clay three to five inches thick, and they were connected by small flues seven inches in diameter running underneath like rabbit-burrows on both sides of the floor. There were no traces of surrounding walls, which were probably of wood and had disappeared, but the approximate dimensions of the floor and platforms or entire chamber were 18 feet from east to west by nine or ten feet. The west end platform was nine feet from north to south by five feet and one foot eight inches in depth; the heating chamber, five feet by two feet six inches along the same lines and nine inches high in the centre of the dome, which sprang directly from the base all round the inside. The thickness of the clay cover was from five inches to one foot two inches. The fire-hole was a square projection, four feet four inches in length by three feet two inches in width, placed underground a few inches lower than the platform on the west side, and connected with the hollow chamber by a flue one foot four inches in length, and ten inches by six inches in width and depth. The sides and bottom of the fire-hole were lined with calcined clay and its top covered with slabs of sandstone and limestone reddened or reduced to powder on the inside by heat.

The corresponding dimensions of the east end platform were nine feet six inches, five feet six inches, two feet ten inches (length, breadth and depth); its hollow interior, seven feet by two feet eight inches and one foot ten inches high in the centre of the dome. Instead of fire-holes two flues, each six to eight inches in diameter, projected four feet four inches from the north side, tapering like a pig's snout from five feet outside diameter to about half and entirely constructed of calcined clay.

There were two large stones in position for forming a door-sill near the middle of the main north wall on the side towards the corridor at 44 feet from edge of the Via, and the surface of the corridor for a distance of 12 feet six inches further eastward was paved with small slabs of sandstone and fragments of red tiles.

The remainder of this end of the corridor was the site of an iron purifying or smithy furnace

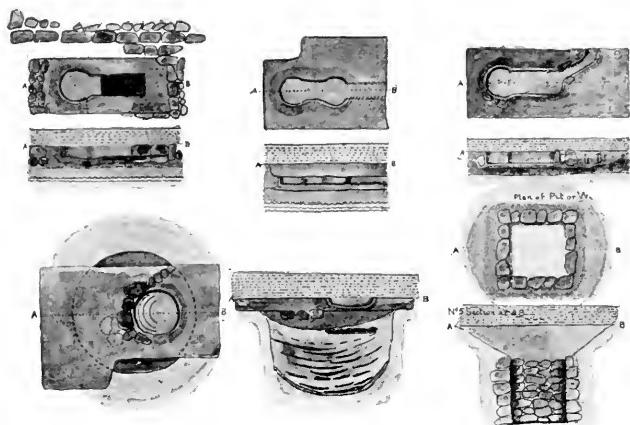
and its accompaniments, which appeared to belong to a secondary occupation of the building and are fully described in Part VI. The original occupier is supposed to have been the owner of the adjoining flint glass furnaces situated both inside and outside the fortification.

EAST SIDE. A walled enclosure uncovered during 1899 on the east side, marked *INSULA III.* on the General Plan, appears to have been built as a pentice or lean-to against the inside of the rampart, there being no other wall on that side. It encloses the extension of the latter, supposed to be a ballistarium, already described. From its south-west angle to the fence of the lawn, where excavation ceases, the length is 73 feet, and its width is from 18 to 20 feet. The following are the internal dimensions of its various divisions: (1), 42 feet by $5\frac{1}{2}$ feet, with extensions at each end, 15 feet by 10 feet and 10 feet by 3 feet respectively; (2), 20 feet by 10 feet; (3), 10 feet by 6 feet, with one extension 10 feet by 3 feet; (4), 8 feet by $6\frac{1}{2}$ feet. Both the inner and outer walls varied in thickness from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet, and are formed of sandstone rubble without any mortar or cement, which may, however, have entirely disappeared.

FURNACES, &c. In the floor of the southern division (1), lying only a foot below the surface at one end of the contracted passage between the two extensions, was a bed of clay measuring about 10 feet in length, $3\frac{1}{2}$ feet in width, and 1 foot in thickness, inside which was enclosed the base of a furnace for heating a caldron or melting-pot. The clay lining of the furnace and stoke-hole was calcined and blanched to a light buff colour, and the soft clay beneath was reddened to a depth of 6 inches by long exposure to heat. The tile floor in front was similarly reduced to a dirty grey by the hot ashes; and the soil from within the upright stone slabs enclosing the latter was impregnated with charcoal.

The following are the interior dimensions of the furnace: oval hearth, 2 feet 3 inches long by 1 foot 5 inches to 1 foot 8 inches wide; stoke-hole, 3 feet 3 inches long by 1 foot $4\frac{1}{2}$ inches wide; upright sides, 8 inches to 1 foot high. In the

WARRINGTON'S ROMAN REMAINS.



BASES OF FURNACES, PIT AND SQUARE WELL (PLAN AND SECTION),
AT WILDERSPOOL.

bottom of the furnace, on the left side, there was a blow-hole or twyer leading from the outside of the bed of clay.

In the floor of the adjoining division (2), lying closely alongside the rampart, there was a similar bed of clay, 10 feet 6 inches long by 4 feet 6 inches wide, enclosing a central oblong cavity, which may possibly have been the central pit of a composite hypocaust, used for warming the apartment, seeing that the whole interior lining was calcined by heat, and there was a narrow flue leading obliquely from one corner and traces of a stokehole at the opposite end. If this supposition as to its purpose be correct, there would originally be a hard burnt clay floor covering the chamber, of the same kind as was found in a more complete example discovered on the west side during 1890, described subsequently. The interior dimensions were:—Central cavity, length 5 feet, width 1 foot 6 inches to 2 feet, height of upright sides, 9 inches; horizontal flue, length 2 to 3 feet, width 10 inches, depth 5 inches.

Outside the walled enclosure, in nearly a direct line westward from those just described, there were two beds of clay of somewhat larger area—(1) 8 feet by 6 feet, (2) 11 feet by 6 feet—which enclosed in their reddened and calcined interior the base of a heating furnace, the walls of which were too much broken down for its intended purpose to be recognized.

The dimensions of the enclosed furnaces were: (1) length, 4 feet 6 inches, (2) diameter, 3 feet.

A rare medallion of Domitian, much corroded, was found directly underneath the north end of the clay floor (2).

Outside the south-west angle of the enclosure, a square pit or well, 3 feet 6 inches across, and 7 feet 8 inches deep, below the present surface, steined with unhewn sandstone blocks about half way up, when cleared was found to contain besides the usual potsherds of common soft red and black unglazed ware and a few pieces of Samian, fragments of a grey vase, with raised trilled edges covering the bulge in a sort of honeycomb pattern, little bits of Castor ware with raised knobs in slip, two inch iron nails, bits of lead and bone, and a piece of bronze mirror about $1\frac{1}{2}$ inch square, containing so large a proportion of tin in its composition as to be smooth and uncorroded on its surface.

During the three seasons 1898-1900, no fewer than 20 similar artificial stages or floors, built up of massive boulder-clay, and enclosing the remains of furnaces, flues, hypocausts, ovens, &c., were examined and recorded. They afford traces of various industries, and differ from anything previously described. The possibility of explaining their destination is as much due to the light they throw upon one another as to the associated "finds," which are purely Romano-British in character.

WARRINGTON'S ROMAN REMAINS.

IV.

CONSTRUCTION OF DWELLING-HOUSES.

No general statement can be made as to the materials and method of construction of Roman dwelling-houses, as they varied according to requirements and local material, and were adapted to the site, aspect, and lie of the ground in the same manner as our own. The rules laid down by their great authority on the subject, Vitruvius, (*De Architectura*), were generally followed, but these rules relate to all sorts of buildings and are contained in ten books, so that any summary of them would be out of the question.

It is, however, possible from the specimens of building materials collected and deposited in our Museum, and from the discoveries made at Silchester (Calleva), Cirencester (Corinium), Caerwent (Venta Silurum) and other Roman towns excavated in recent years, to form very definite ideas of the superstructure of the Roman houses at Wilderspool and Stockton Heath. Many of the latter were mere huts for slaves or sheds for covering workshops; a few were retail shops or dwelling-houses; and there was probably a forum, basilica, and temple as in all Roman towns. Between them there was a great difference in construction, just as there was a vast distinction between the emperor's palace, with its glass and marble walls, mosaic pavements, silver water pipes, and bronze roofs, and the straw-thatched, clay built casæ of the peasantry in Rome itself.

HUTS OR SHEDS FOR WORKSHOPS. Of the existence of these huts and sheds (*casæ, canabæ*), there is abundant evidence in the shape of 20 or 30 detached clay floors, usually placed square with the *Via*, but without any order or any trace of surrounding walls, which being of wood, have decayed by time or been destroyed by violence. Such floors are still quite common for the kitchens and oothouses of Lancashire and Cheshire farms, and for cottages in the remote parts of Scotland, Ireland, and Wales, and their durability is proved by their existence after 15 or 16 centuries.

They have usually a hearth in the shape of a raised platform of the same material at one end, set round with kerb-stones and reddened and calcined by heat along the middle.

There is a curious piece of evidence that some of these erections on the north side of the *civitas* were thatched in the shape of a sling-ball of red baked clay, roughly spherical, $1\frac{1}{2}$ inch in diameter, and weighing $1\frac{5}{8}$ oz., which was found at the bottom of a leat or drain, along with corroded iron pellets, and a three-bladed and barbed iron arrow head close to the bronze founder's workshop. Red-hot baked clay sling-balls and fiery darts are stated by Cæsar (*De Bello Gallico*, V., 35) to have been used by the Nervii against Cicero's camp during a high wind to set fire to the soldiers' huts which were straw-thatched (*quae more Gallico stramentis erant tectæ*), and the discovery at Wilderspool of such missiles, which have also been met with at Ardoch, Glastonbury, Mount Caburn, Highfield, &c., indicates that their use was general among the Celtic tribes during a siege, and that they were so used at Wilderspool.

DWELLING-HOUSES AND RETAIL SHOPS. Among the building materials from Wilderspool and Stockton Heath deposited in the Warrington Museum are:—Bricks: (1) measuring $7\frac{7}{8}$ by $7\frac{5}{8}$ by $2\frac{1}{2}$ inches (two-thirds of a Roman foot), ornamented on one surface with diagonal ogee curves terminating at the four corners in leaf-shaped loops, — an example of the *lateralculus bessalis* of Vitruvius (*De Architectura*, V., 10); (2) measuring $15\frac{1}{4}$ by $10\frac{3}{8}$ by $2\frac{1}{4}$ inches (one and a half by one Roman foot), an example of the *Lydium* or *sesquipedalian* of Vitruvius, one of the commonest patterns. Besides these, which were found too deep down to be got at by the plunderers, there were many fragments. They were evidently made from heavy clay, well tempered by long exposure, being very dense and hard. The modern practice is to use the lightest possible clay right off without any tempering. These bricks were principally used by the Romans for

WARRINGTON'S ROMAN REMAINS.

lacing and bonding courses and quoins in flint and rubble walls, for turning arches, and for covering hollow floors of hypocausts. Only very important edifices were mainly constructed of brick, such as the basilica of Treves (Augusta Treverorum), the capital of the Western Empire in the reign of Constantine the Great, which is still standing.

TILES. There are no specimens of the large flanged tiles of red terra-cotta generally employed by the Romans for covering their houses, as at Chester, Melandra near Glossop, &c. Stone roofing flags were used instead, as at Wroxeter, and broken ones are lying in heaps on the site of the large house now being excavated at Stockton Heath. They are usually hexagonal in shape, each side measuring about 6 inches, but those at the ridge are triangular, and the bottom ones square to complete the covering. Their top edges were bevelled to lighten them. Enough whole ones are in the Museum to show the pattern of the roof, several retaining the iron nails in the holes for fastening them.

Several fragments of the semi-cylindrical tiles called imbrices, intended for covering the sloping flanges of the large square terra-cotta tiles, but used in this instance to cover the ridge along the edge of the stone flags, have been met with among the latter at Stockton Heath.

FLE TILES. These are of red baked clay, rather less than an inch thick, and shaped like a square tube (hollow parallelopipedon), with an opening on one side to admit hot air into the apartment. They were very plentiful, as shown by the number of pieces used for paving floors and other secondary purposes. In the Museum there are one or two restored sufficiently to show their dimensions which are (1) 7 inches square by $1\frac{3}{4}$ inches in length, with an oval hole on one side $2\frac{1}{2}$ by 3 inches in diameter, (2) 6 $\frac{1}{2}$ inches square by $1\frac{1}{2}$ inches in length (one Roman foot). Outside they are also scored on one side with wavy lines to secure adhesion of the cement, and more frequently scratched with a trellis pattern like the paving tiles used in our streets. They were built into walls, or nailed against them with T-shaped iron clamps, in the winter rooms of the better class houses, which

were heated not by inside fires, but by means of hollow floors (hypocausts) connected with fire-holes on the outside, a slave being in attendance there to maintain the fires. These flue tiles were joined end to end like little chimneys, and conveyed the hot air and smoke from the underground channels up to the eaves of the roof sometimes on one side only, but usually on all four sides of the apartment.

IRON. In the Museum there are several of the T-clamps for fastening flue tiles and revetting tiles to walls; and a large number of stout nails about 2 inches in length with large round heads for fastening stone flags to roofs. Nails of larger size up to 10 inches in length of square section with proportionately large heads were plentiful, indicating that heavy wooden frames were employed in the construction of houses. In places where such large nails were found without any traces of stone walls it was concluded that the surrounding structures were mainly of wood. A number of keys 4 to 5 inches in length, with webs bent at right angles 2 inches long, and two or three half-inch bits, indicate that the doors of the houses were provided with locks; and a box lock $3\frac{1}{2}$ inches square by 1 inch thick, with the two round-headed nails 3 inches long driven obliquely through holes in the corners into the wood and preserved from decay by a non-corrodible lacquer or varnish and a covering of charcoal and clay, was found near to the blacksmith's shop. There is also a loop hinge with fastening plate 5 inches in length, and the head of one bolt in position; also two or three broken and corroded hoops of strap iron which were fastened to the ends of the wooden pivots of doors and gates to resist wear, such as were found inside their socket holes at the gates of the camps along the line of the Wall of Hadrian. One of the socket-stones found near to the S.W. gateway of the fortification has already been referred to. A smaller one found at Stockton Heath is also in the Museum.

LEAD. Sheet lead was extensively used by the Romans in the construction of their houses and baths, and in providing a water supply, which was laid on in nearly the same manner as our own. The quantity of sheet lead, strips, and clippings obtained are sufficient evidence that it

WARRINGTON'S ROMAN REMAINS.

was largely used upon the houses at Wilderspool for various purposes.

GLASS. Plate or cast glass in an unpolished condition and of an impure bluish-green tinge was quite common. Many fragments were collected on the west and north sides of the principal fortification at Wilderspool. The largest measures about 3 inches square and 3-16th inch thick, but a single pane of similar character found in the gable end of the apodyterium of the baths at Pompeii measured 3 feet 8 inches wide by 2 feet 8 inches high and 2-5th of an inch thick. Glass was as commonly used in Roman times as now.

BRONZE. The only specimens of internal fittings in brass or bronze are (1) a cover plate or boss for the handle of a door, and (2) a staple or holder for a curtain rod, both very much injured by corrosion. Many small personal ornaments in bronze which have been found will be described later.

CARVED STONES. Unfortunately these are of extreme rarity. They were originally above ground and conveniently placed for plunderers. The base and capital of a column apparently in the Corinthian style of architecture have been a long time in the Museum; and part of a cornice with fillet and cyma recta, in debased classic, has recently been added. The latter was found used over again with the moulding hidden along with rough stones in a wall of three courses, 40 $\frac{1}{2}$ feet in length, adjoining the east side of the Via at "Roman-road," Stockton Heath.

There were also found in position and not removed two or three large stones with square mortice holes for receiving the tenon of an upright wooden post. Another measuring 20 by 18 by 13 inches, with a mortice hole 3 $\frac{1}{2}$ inches square by 3 inches deep, was taken out of a well. Such stones are clear evidence of the use of large upright wooden posts in the construction of adjoining buildings.

The sparse remnants above described are sufficient to show that they belonged to houses of similar construction to those in other Roman towns already mentioned, where the remains discovered are more complete. At Silchester, during 1901, a house was excavated, of which part at any rate was of "wattle and daub," on dwarf walls of masonry. The fire by which it was destroyed had converted the thick clay plaster into brick, and caused it to retain the impression of the wattles on one side and a zig-zag pattern stamped roughly upon the other. A farm building at Spoonley Villa, Gloucestershire, beside the country residence of a wealthy Roman, had "two rows of pillars supporting the roof and dividing it into a nave and two aisles, 54 feet long by 34 feet 8 inches wide. The stone bases of the wooden pillars rest on rough foundations, and in the top of each block is cut a mortice hole to receive the tenon of a wooden post, dimensions 15 by 17 inches, mortice 4 inches square by 3 inches deep." (*Archæologia*, vol. LIL, part 2, p. 651). The house now being excavated at Stockton Heath has a row of similar rough foundations for six pillars, its dimensions being 56 feet long by 32 feet 6 inches wide, or nearly equal to those at Spoonley Villa. Every house in Pompeii had at least one upper floor, and the Romans appear to have had as great an objection as ourselves to sleeping on the ground floor. A thickness of ashlar walling of 2 $\frac{1}{2}$ and 3 $\frac{1}{2}$ feet, such as has been found in our own Roman oppidum, proves that the houses in question were at least two storeys in height. They were also roofed with stone flags laid on timbers of great strength supported partly on wooden pillars. They are therefore the prototypes of the half-timbered houses still met with in Lancashire and Cheshire, such as Speke Hall and Old Morton Hall, from which they are removed only two or three generations by lineal descent, the generations of such houses being very much longer than those of their inhabitants.

WARRINGTON'S ROMAN REMAINS.

V.

BRITAIN'S EARLIEST IRON FURNACES.

HAND BLOOMERIES.—The discovery of iron-smelting furnaces of the Roman period is the most interesting yet made upon the site owing to its novelty, its variety and completeness, and its relation to one of the staple products of our town of many industries. Saw kiln floors, calcining ovens, smelting and crucible or refining furnaces have been uncovered in four separate spots; specimens of clayband and hematite ores, unspent charcoal and cannel and ordinary mineral coal, slag and cinder, and iron in separate stages of manufacture (cast and pure) have been collected from the vicinity of the furnaces and deposited in the Museum; and no fewer than 20 samples of ore, slag, cinder, and

calcined clay from the walls of furnaces (the nature of which will be fully specified) have been analysed by Mr. Andrew Harley, of the Coalbrookdale Co., Limited (through the intervention of Mr. F. W. Monks, of Messrs. Monks, Hall and Co., Warrington), and by Mr. Fredk. G. Ruddock, F.I.C., public analyst, an expert of long experience in the analysis of iron and its ores.

The antiquity of the slags has been demonstrated by their composition; association with abundant fragments of Samian and other descriptions of Gallo-Roman and Romano-British pottery and coins of the Higher Empire, leaves no uncertainty as to the Roman origin of the furnaces.

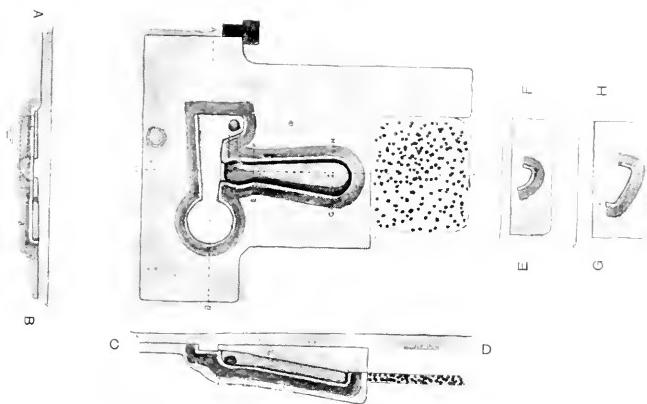


BASE OF SMELTING FURNACE (WEST VIEW), WILDESPPOOL, NEAR WARRINGTON.

WARRINGTON'S ROMAN REMAINS.



BASE OF IRON SMELTING HEARTH (EAST VIEW), AT WILDERSPOOL.



IRON SMELTING FURNACES FOUND AT WILDERSPOOL 1899.

WARRINGTON'S ROMAN REMAINS.

IRON FURNACE I. The earliest discovered and most complete of the iron smelting furnaces (I.) was on the top of the slope at the south-west corner of the Wilderspool brewery field, at 31 feet from south fence of the latter, and 27 feet from the face of the western rampart, and was covered by only six to nine inches of surface soil (most of which had been previously removed to the adjoining sand pit). It consisted of a roughly T-shaped furnace cavity enclosed in a platform of stiff boulder-clay. The latter was from 6 inches to 2 feet 6 inches thick, in the shape of two oblongs conjoined, measuring 13 feet 4 inches by 5 feet, and 9 feet 6 inches by 6 feet respectively, both lying lengthwise from north to south or in line with the Via. In the midst of the larger or west limb of the platform and forming the cross-head of the T was a circular pit 2 feet 4 inches in diameter and 3 to 4 inches in depth, having a fantail-shaped flue or stoke-hole opening from it northwards, 4 feet 4 inches in length, its width increasing from 1 foot to 2 feet 1 inch, and its depth decreasing from 4 inches to 1 inch outwards. Striking off at right angles to the flue at 1 foot 3 inches from the circular pit there was a sloping trough closed at the outer end with clay, 6 feet 6 inches in length, its width increasing from 1 foot to 1 foot 11 inches, and its depth from 6 inches to 1 foot 6 inches below the level of the flue, thus forming a gutter and basin for directing and collecting the molten stream from the furnace. A covered duct or return pipe from the outer end of the flue to the top of the sloping trough, and passing through the clay floor, served to convey any molten metal into the trough which had run past its open mouth.

The interior of these cavities was calcined to a dirty grey or light buff terra-cotta for a depth of 2 inches, and the clay for more than a foot beyond was reddened by long continued heat.

The solidity of the base of the furnace indicates that it was a permanent structure, and though there was no trace of a chimney, it may be inferred that the circular hearth or pit was surmounted by a shaft of greater or less elevation, probably three or four feet, for creating a draught. The flue and sloping trough were also partly or entirely overarched, the latter be-

ing found completely choked by a mass of clay reddened by heat and fragments of calcined upper crust from its overarched covering.

From the shape of the cavities it may be concluded that the iron ore was smelted by a continuous process, whereby the products of the circular hearth were at proper intervals run down into the basin at the bottom of the V-shaped gutter, and there separated. The lighter slag was probably removed by levigation or skimming over the lip of the basin, and the iron then ladled or tapped into clay moulds.

These conclusions as to the mode of working drawn from the shape of the furnace were confirmed by the position just outside the rim of the basin, at from 2 feet to 2 feet 6 inches below the grass, of a deposit blackened by spent charcoal, fully 9 feet in diameter and 6 inches deep of slag mixed with fragments of cannel and ordinary mineral coal in little cubes, as well as two nodules of clay-ironstone and two small fragments of red haematite. The analysis of the latter by Mr. Harley gave the following results:

	No. 1.	No. 2.
Ferric oxide	90.560	96.12
Iron pyrites	—	1.05
Alumina.....	—	slight trace
Lime	slight trace.....	"
Magnesia	"	"
Phosphoric.....	"	"
Sulphuric	"	—
Manganie	—	"
Siliceous matters	9.384	1.75

Both samples were red when ground, No. 1 containing more impurity, and No. 2 being very hard and slightly crystalline on the edges. Several lumps of the slag were examined by him but found to be very much alike, and the particulars of only one need be stated.

Silica.....	59.65
Alumina.....	13.41
Manganic oxide .....	.20
Ferrous oxide	18.14
Ferric oxide	3.84
Phosphoric acid .....	.48
Iron pyrites	1.46
Carbonaceous matter and moisture	3.18
	—
	100.36

WARRINGTON'S ROMAN REMAINS.

In the opinion of Mr. Ruddock, "such a composition of slag could only be produced direct from the ore, at a high temperature, in a smelting furnace." That it is an ancient slag is evidenced by the entire absence of lime, of which from 20 or 30 per cent. is usually found in modern slag, the use of lime as a flux for removing silica being unknown to the ancients. A large proportion of the iron itself was, in consequence, necessarily consumed for fluxing the silica, causing great waste of material, as will be seen from some of the analyses of slags to be given subsequently.

In order to leave no room for doubt as to the purpose for which the furnace was employed, the composition of the calcined skin from its interior was ascertained by Mr. Harley, with the following results:—Silica 53.00, alumina 22.17, lime 2.07, magnesia 3.38, oxide of iron 8.40, water of composition 5.44, moisture at 100degs. C. 3.3t. The percentage of ferric oxide in the natural clay of which the furnace was constructed is only 2.43, showing that a good deal of iron was absorbed from the operations.

That the Romans made and used cast iron, though formerly denied, is now certain, from the discovery in 1901 of a Roman cast-iron statuette in a slag heap at Beaumont Park, near Hastings, with other remains, which were exhibited in Lewis Castle on the 19th December, 1902; and from the composition of a squarish block of cast-iron found beside the iron purifying or crucible furnace I., already referred to and to be described later.

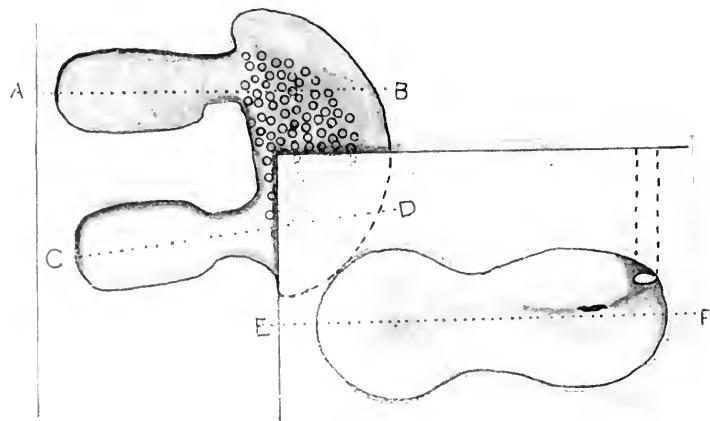
The Roman origin of the furnace last described is thus evident from its surroundings and posi-

tion inside a Roman town with a population engaged in various industries. It is also proved by the following list of objects found in its immediate vicinity:—Plain bronze ring $\frac{3}{4}$ -inch in diameter; iron knife, a number of iron nails about 2 inches in length; flat disc-shaped spindle-whorl of lead, 1 inch in diameter, and $\frac{1}{4}$ inch hole, $\frac{1}{2}$ inch thick. POTTERY. Small broken and distorted hand-lamp (*lucerna*), of common soft red paste; two whole members of a triple vase of the same kind of ware, washed over with thin white clay slip, with internal communication, globular in shape, $2\frac{1}{2}$ inches high; portion of mortarium of white Broseley clay, broken and worn away at the base, stamped with potter's name, *GENIALI*, across the rim, found 2 feet below the clay floor adjoining the flue or stokehole of the furnace; broken handle of amphora stamped with potter's name, *QASASER*; fragment of base of amphora, scratched with number *Ixiiii* ($63\frac{1}{2}$ ounces), indicating the weight of the empty vessel; fragments of so-called Samian, embossed and plain; necks of ampulke of red and white paste; many fragments of olke and patelke of common soft red and black smoke-tinted ware; brick, measuring $7\frac{1}{2}$ by $7\frac{1}{2}$ by $2\frac{1}{2}$ inches, or two-thirds of a Roman foot; broken pieces of stone roofing slabs.

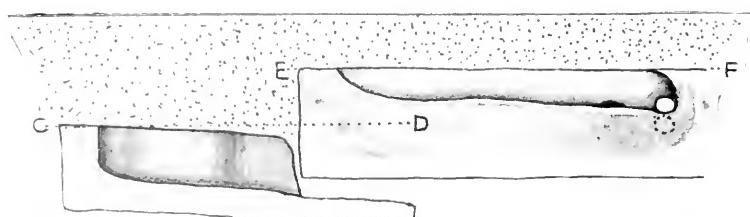
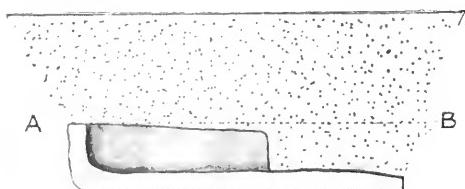
Traces of an enclosing wall belonging to a shed or workshop were found a few feet south from the furnace; and upon the north side a layer of yellow powdery burnt sand and a small flagged pavement. On the east side investigation was stopped by the plantation, and on the west by the old sand pit, which were close at hand.

WARRINGTON'S ROMAN REMAINS.

PLAN



SECTIONS



DOUBLE FURNACES AND IRON SMELTING HEARTH. II.

WARRINGTON'S ROMAN REMAINS.

SMELTING HEARTH II.—The base of another rude iron smelting hearth was situated on the north side of the brewery field, about mid-way between the east and west ramparts, and 21 feet from the inside edge of the Via. It was upon the middle surface of an oblong massive clay platform from 1 to $1\frac{1}{2}$ foot thick, uncovered at $1\frac{1}{2}$ foot below the grass, and measuring 8 feet 9 inches from east to west by 1 feet. The furnace cavity was in the form of a deep foot-print or two intersecting ovals, each about 2 feet 6 inches in width, their conjoined length being 6 feet 4 inches. The interior surface was calcined and blanched to a depth of 3 inches, and the soft clay underneath reddened to a further depth of a foot by the intense heat. The base of the furnace was constructed with a double batter, from both sides towards the axis and along the latter towards the east end, and formed into a sloping trough or gutter, leading down to a tubular duct, 1 foot 10 inches in length and $4\frac{1}{2}$ inches in diameter, through the wall of the clay platform at right angles, by which the molten metal was drawn off, as evidenced by its calcined interior lining. The purpose for which the hearth was employed is proved by the discovery of a much oxidized strip of iron deeply imbedded in a crack along the middle line of the trough near the exit, where it had doubtless lain since the last charge was smelted; and by the discovery of a mass of red haematite ore, of several pounds weight, in the clay platform of an earlier furnace existing partly underneath the former and partly along its edge, whence the mass had apparently fallen. The results of analysis of the iron strip by Mr. Ruddock are the following:—

Carbon, combined	0.060
Silicon	trace
Sulphur.....	0.027
Phosphorus	0.037
Manganese	trace
Iron, by difference	99.876
<hr/>	

100.

In his opinion this specimen was a pure variety of soft iron made from magnetic ore or red haematite, and purified from cast iron, as such

a low percentage of carbon would have been practically impossible if made direct from the ore in this rude furnace.

Many lumps of heavy slag were scattered up and down in the ash-blackened stratum surrounding this and a number of other adjoining furnaces. One of the lumps was basin-shaped, about 6 inches across, and so heavy and rusty as to be taken for a mass of iron, until analysed by Mr. Ruddock, who found it to contain:—

Ferrous oxide.....	51.80
Ferric oxide	6.73
Manganese .....	.26
Alumina	5.20
Lime.....	3.00
Magnesia.....	1.17
Silica	28.07
Phosphoric acid.....	.43
Sulphuric acid19
Organic matter and water.....	1.70
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	98.55

The large amount of alumina shows that it was made from clay iron-stone.

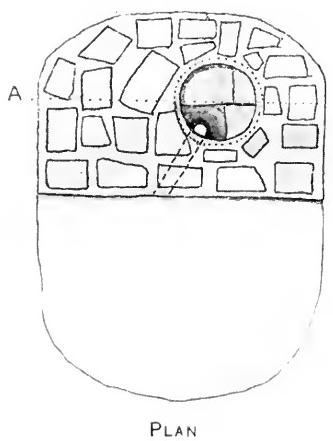
Most practical authorities believe that the ancients produced their iron solely from the purest ha-matite ores by a very simple process of heating calcined and broken pieces for a few hours in a shallow pit or crucible with a charcoal fire forced by bellows introduced over the top, and then hammering the "blooms" or soft lumps of hot iron to expel the cinder or scoria. But many pieces of clayband or impure ore have been found beside the roasting ovens at Stockton Heath, and, being skilled metallurgists, the Romans were probably aware that a mixture of the two ores gave a better proportional yield and was more fusible than when each was smelted separately, the one supplying what the other lacked in the form of a flux to run off the combined silica and set free the iron. The analyses likewise show that impure clayband and spathic ores were employed.

The mode of working which was practised at Wilderspool and Stockton Heath will be more fully considered after the purifying or crucible furnaces have been described.

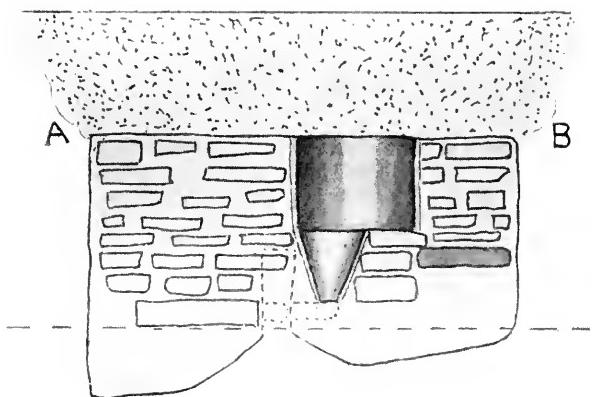
WARRINGTON'S ROMAN REMAINS.



IRON PURIFYING FURNACE OR SMITHY HEARTH AT WILDERSPOOL.



PLAN



SECTION

WARRINGTON'S ROMAN REMAINS.

VI.

SMITHY OR REFINING FURNACE I.—The position of a refining or crucible furnace (*catus*) at the end of the long corridor or alley adjoining a dwelling-house and extending at right angles from the west Via has already been noted in part III. Though the trades of iron manufacturer and blacksmith at the present day are usually separate ones, the division of labour in Roman times was not so complete, and the crude or cast-iron from the smelting furnaces was not only refined and rendered malleable in this ancient ferraria (so named from the material *ferrum*, iron), but also welded into useful forms upon the spot. From its size it will be perceived that the operations were on a diminutive scale, and the method employed an extremely simple one.

The hearth itself was a roughly semi-circular stage or platform, built up of broken tiles and bricks in five courses, set in stiff boulder-clay with wide joints for mortar, and enclosing a cylindrical pit or crucible (*catus*), the interior of which was lined with calcined clay. Dimensions: Platform, length (diameter) 3 feet 6 inches, width (radius) 2 feet 6 inches, vertical height 1 foot 10 inches to 2 feet 2 inches; fire-seat or crucible, diameter 11 inches, depth 9 inches.

From the base of the crucible a funnel, 6 inches wide at the top and 2 inches at the bottom, lined with broken tiles, extended downwards 7 inches and opened into the front of the hearth by a narrow gap $2\frac{1}{2}$ inches wide between the tiles. This appears to have been the tap-hole for running out the cinder or scoria.

A semi-circular floor of clay 2 feet 6 inches in diameter and 2 or 3 inches thick lay in front of the hearth at 1 foot 8 inches below its summit, and a yellow powdery layer of burnt soil surrounded both floor and platform.

In front of the clay floor there was a deposit of unspent charcoal in lumps, showing the original grain of the wood. A few bits of cannel coal were also met with.

Only one lump of heavy slag was found in the immediate vicinity of the furnace, but there was

a deposit of light "cinder" (silicate of iron) outside the south-east angle of the adjoining house, at 35 feet south from the furnace; and in the wall of the crucible, underneath the calcined lining, there was a small globule of glassy "cinder," the analysis of which is given below (No. 3), indicating that the refining of iron was the purpose for which the furnace was used. There was also a block of cast-iron (about 2 inches by 1 inch by 1 inch) the analysis of which is also given below (No. 1). The iron objects found close at hand were fourteen nails, 2 to 3 inches in length, with round flat heads; three hob-nails, $\frac{1}{2}$ -inch in length, with conical heads; two clamps; hook; about half of a box-lock of thin iron plate; handle of an iron knife or dagger, 4 inches in length, $\frac{3}{4}$ -inch in diameter, formed out of a flat middle plate of iron and two half-round outer plates of bone, fastened together by two iron rivets, 1 inch apart, passing through them. The pommel or projecting end of the middle plate is perforated for suspension by a lanyard. The two outer plates of bone are ornamented with incuse lines in three encircling bands $\frac{1}{8}$ of an inch wide, forming a trellis pattern or diamond lattice at both ends and a chevron in the middle. The blade is broken off close to the hilt, which has no enlargement. What appear to be two portions of the broken blade, which fit together at the broken ends, but are coated with a thick mass of consolidated sand, oxide of iron, and portions of a wooden sheath, measure $6\frac{1}{2}$ inches in length when conjoined, making a total length of blade and handle, $10\frac{1}{2}$ inches (found under the deposit of charcoal and a thin layer of clay).

Lead.—Two spindle-whorls, slightly conical (1), 1 inch in diameter, $\frac{1}{2}$ -inch thick, the bore tapering from $\frac{1}{4}$ to one-sixteenth of an inch; (2), eleven-twelfths of an inch in diameter, $\frac{1}{4}$ of an inch thick, bore $\frac{1}{4}$ of an inch.

Pottery.—Potshards of common soft red and black smoke-tinted unglazed wares, and a few fragments of bright red glazed Samian. A whole

WARRINGTON'S ROMAN REMAINS.

plate, of coarse brown paste, cracked half across, 11 inches in diameter, $1\frac{1}{4}$ inch deep, $\frac{3}{8}$ inch thick, rim $1\frac{1}{4}$ inch wide, with a graceful ogee curve and deep groove round the edge, found in the clay floor of the furnace.

Two coins, a first bronze of Domitian and a second bronze of Trajan, found along the edge of the long wall adjoining, at 1 foot 3 inches and 1 foot 6 inches from the surface respectively.

No fewer than 60 iron nails of various sizes were found in a rubbish pit, opened out at a distance of 45 feet nearly in a direct line south from the furnace.

The most interesting find close to the furnace was an iron tube, about 8 inches in length, $1\frac{1}{2}$ inch external and five-sixths of an inch internal diameter, $\frac{1}{8}$ -inch thick, hollow inside, but coated on the outside with a thick concretion of sand and rust. The tube itself was too much oxydised for analysis. It appears to have been the nozzle of the bellows for working the crucible, and was probably introduced over the top.

The analysis of three specimens of iron and slag from the crucible furnace I, by Mr. Rud dock, gave the following results:—

(1) A squarish block of iron (about 2 by $1\frac{1}{2}$ by 1 in.), coated with scale.

Carbon, combined	0.230
Carbon, as graphite.....	3.000
Silicon	1.050
Sulphur	0.485
Phosphorus	0.756
Manganese.....	0.403
Iron, by difference	91.076

This he described as a sample of cast iron, extremely brittle, smelted with coal from an impure ore, probably spathic, owing to the high phosphorus; and with a sulphurous coal, owing to the remarkably high sulphur.

(2) A piece of wrought iron resembling a cotter or ynnch pin.

Carbon	0.090
Silicon	0.060
Sulphur.....	0.031
Phosphorus	0.257
Manganese.....	trace,
Iron, by difference	99.562

The high proportion of phosphorus led him to conclude that it was produced from an impure ore, and that it was probably made from cast iron and not direct from the ore.

(3) A small globule of cinder from the wall of the furnace, underneath the calcined lining.

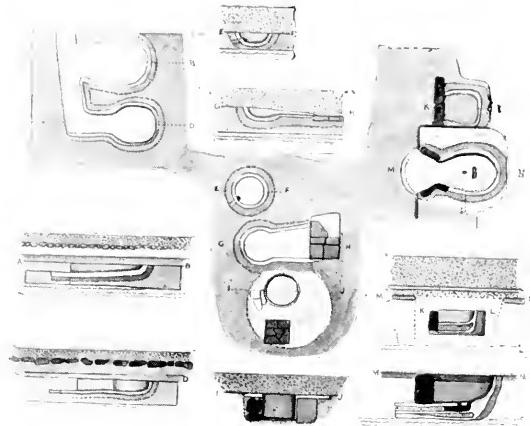
Silica	73.800
Ferrous oxide	17.5
Ferric oxide	1.2
Alumina	1.7
Magnesia	0.55
Phosphoric acid	0.724
Sulphuric acid	1.650
Alkalies, &c.....	2.876

Such a stag as this, he inferred, would be obtained by reducing an ore containing appreciable quantities of phosphorus and sulphur.

REFINING FURNACE II.—A small pit or crucible of cylindrical shape, 1 foot 8 inches in diameter, and 1 foot 3 inches deep, was found sunk below the middle portion of an extensive clay floor 25 feet from north to south by 20 feet, and 4 inches thick, on the north side of the oppidum, at 13 feet in a direct line westward from the smelting hearth II., described in part V. This also was evidently used in the iron refining process. The surrounding surface of the clay floor over an area 4 feet 6 inches in diameter was calcined and blanched to a dirty grey by the hot ashes, and became known as the "white hearth."

ORE ROASTING OVEN I.—Adjoining the "white hearth" on the north side in the surface of the same clay floor there was a basin-shaped cavity, 1 foot 8 inches in diameter and 7 inches deep in the middle, having on one side a fan-shaped flue or stoke hole, both calcined internally by heat. The latter was 1 foot 9 inches in length, widening outwards from 1 foot 4 inches to 2 feet 2 inches, and sloping downwards to a square hearth paved with bricks, which were cracked and whitened by the hot ashes raked from the furnace. From its calcined interior and the quantity of burnt clay fragments it contained, this was concluded to be an ore roasting oven, the covering of which had been broken down by the plough or spade owing to its nearness to the present surface, namely, from 1 foot to 1 foot 4 inches.

WARRINGTON'S ROMAN REMAINS.



GENERAL PLANS AND SECTIONS OF IRON SMELTING FURNACES
AND SUPPOSED GLASS FURNACES (NORTH SIDE),
WILDERSPOOL, NEAR WARRINGTON.

REFINING FURNACE III.—Only 1 foot 3 inches further northwards on the same floor there was a smaller basin, 1 foot 6 inches in diameter, and 6 inches deep in the centre, having a hole about 3 inches in diameter on one side, which may have been used as a tap-hole for removing the "cinder," or a twyer-hole for introducing an artificial blast. This basin was probably the fire-seat of a smithy hearth, being calcined throughout.

Ore Roasting Ovens II. and III.—A pair of long oval furnaces existed partly underneath the north-west corner of the smelting hearth II. Their dimensions were—

II.—Length, 2 feet 6 inches; breadth, 1 foot 6 inches; depth, 1 foot. Fire-hole: length, 1 foot; breadth, from 1 foot to 1 foot 8 inches.

III.—Length, 2 feet 8 inches; breadth, 1 foot 4 inches; depth, 10 inches. Fire-hole: length, 8 inches; breadth, from 10 inches to 1 foot 6 inches.

Symmetrically laid in front of both their openings there was a semi-circular hearth of hard-baked clay, ornamented all over with rings, 1 $\frac{3}{4}$

inch outside diameter, stamped evenly without intersecting on the surface of the soft clay previously to baking. These ovens were only 1 foot 2 inches apart in the same clay platform, which was found 2 feet below the grass.

From their shape and position and from the mass of haematite ore (referred to on page 23) embedded in the clay, it may be inferred that they were used for roasting or calcining the ore previous to smelting in the smelting hearth II. erected above.

Further evidence of the intended purpose of this group of furnaces, and of their early date, 1st to 5th century, was afforded by a deposit 9 feet across of black glossy cinder, found on examination of samples by Mr. Ruddock to be essentially silicate of iron, or slag produced by iron smelting, which was situated at the north-west angle of the clay floor, and by the ash-blackened stratum surrounding the latter.

The following are the reliques of Romano-British origin with which these deposits were impregnated:—A large iron nail, of $\frac{3}{4}$ -inch square section, 9 inches in length, with a round head 2

WARRINGTON'S ROMAN REMAINS.

inches in diameter; a strip of iron $\frac{1}{2}$ -inch to $\frac{5}{8}$ -inch wide, $\frac{1}{8}$ -inch thick, perforated at one end; the figure of an animal, possibly a rude representation of the wild boar of the 20th Legion, formed of sheet lead about $\frac{1}{8}$ -inch thick; two small strips of sheet lead of about the same thickness; a fragment of a common black, smoke-tinted unglazed earthenware olla (resembling Upchurch ware), with a hole about $\frac{1}{4}$ -inch across, wastefully patched with a plug of lead weighing 2oz., projecting on both sides (this leaden plug indicating not the high value attached to the black pot, but the abundance of lead in the locality); an ordinary melon-shaped ribbed bead, of grey vitreous

By means of these discoveries and researches the following facts have been ascertained as to the mode of working practised by the early iron manufacturers in the locality—

(1.) The composition of the slags varied from about 80 per cent. of silicate of alumina and other impurities and 20 per cent. of oxides of iron to about 75 per cent. of the latter and 25 of impurities.

(2.) The small proportion of lime present in the slags shows that it was merely an accidental impurity, and was not added intentionally as a flux.



PAIR OF SUPPOSED ORE FURNACES, WILDERSPOOL,
NEAR WARRINGTON.

paste, coated with blue glaze, $\frac{1}{4}$ -inch in diameter, and $\frac{1}{4}$ -inch bore; the broken half of a similar bead; a first bronze coin of Trajan, much corroded, found at a depth of 2 feet 6 inches; a second bronze coin, too much corroded to be deciphered, found in the upcast soil; an iron stylus, $4\frac{1}{2}$ inches in length, $\frac{1}{8}$ -inch thick, pointed at one end and spatular at the other; several round headed nails, about 2 inches in length, much oxidised; several fragments of so-called Samian and ordinary black and red unglazed earthenware, and a small fragment of a melting-pot or crucible; the neck and portions of the handles of a large amphora.

(3.) The quantity of alumina in the slag and a large number of specimens prove that clay-band ores were principally used.

(4.) Pure silica in the form of pounded white quartz pebbles appears to have been added as a flux (for the haematite ores), the black glassy specimens of slag when pounded being found under the microscope to contain a large proportion of these white particles, with occasional lumps half an inch in diameter.

(5.) Mineral coal, principally cannel, was employed as well as charcoal or dry wood, for smelting, many pieces of cannel being collected in the Roman stratum and deposited in the

WARRINGTON'S ROMAN REMAINS.

Museum, as well as smoothing tools or burnishers of the same material, and its use as fuel having been demonstrated in more than a dozen other Roman settlements.

(6.) The "follis fabrilis," or blacksmith's bellows, resembling our own, and other artificial methods of forcing combustion were in use here as in other localities.

GENERAL CONCLUSIONS.—The foregoing details of (1) the construction and surroundings of three different kinds of furnaces, viz., ore roasting ovens, melting hearths, and crucible or refining hearths; (2) two kinds of fuel, cannel coal and ordinary mineral coal in the former, and charcoal in the latter, for the manufacture of iron; (3) the results of analysis of specimens of ore, slag, cinder, crude or cast iron, and finished iron derived from these furnaces; and (4) the opinion of an expert in regard to them, are strong evidence in support of the view that an indirect method of producing crude or cast iron in one furnace, and re-heating it in another with charcoal to convert it into pure or malleable iron, was practised in this locality. This view receives further support from the discovery this season on the south side of the oppidum of another similar group of furnaces to be described later.

The earliest writer upon the subject, Pliny, speaks of a method of hardening iron by quenching in water, and of the use of oil for the same purpose. A 16th century writer, Georgius Agricola, "De Re Metallica," lib. ix, p. 337-339, gives a very clear description of two separate furnaces, the melting hearth (*rinnherd*) and the crucible hearth (*sehmidherd*), for iron smelting. The latter was used in the production of soft malleable iron or "blooms," direct from the purer ores by a single heat, with charcoal for fuel, in conjunction with a forced draft by bellows and a tilt-hammer, both driven by a water-wheel. The hearth was $3\frac{1}{2}$ feet high, 5 feet long and broad, in the middle of which was a crucible (*catinus*) a foot high and a foot and a half wide, the dimensions, however, varying according to the requirements. The crucible appears to have been lined with powdered charcoal (two parts), powdered earth (one part), mixed together and moistened with water, and then beaten down with a pile or rammer in

such a way as to form a circular cavity a foot wide, 8 inches deep. Ore and charcoal in alternate layers were heaped up and the fire lighted inside the crucible, combustion being forced by means of a tube introduced over its edge connected with bellows.

Impure ores not only underwent a preliminary process of roasting, washing and powdering, but



IRON SMELTING FURNACE FOR IMPURE ORES.

ILLUSTRATION TAKEN FROM AGRICOLA.

were actually melted by prolonged heating in a much larger furnace before being removed to the crucible furnace for refining with charcoal and welding into blooms. Agricola's description of the process is sufficiently brief and explicit to be quoted in extenso (the translation being my own):

"More labour and a fiercer heat are requisite for cuprous or refractory ore, since the portion containing the metal has not only to be divided from the rest and disintegrated with dry stamps, but it must also be roasted to sublimate other metals and noxious salts, and washed to separate the lighter portions. It is to be smelted in a

WARRINGTON'S ROMAN REMAINS.

furnace similar to the first (shaft furnace), but much larger and loftier, to contain much more ore and charcoal, and to be charged alternately with ore in fragments no larger than a nut and with charcoal, which are thrown in by the smelters, who ascend the steps on one side of the furnace. From such ore, sometimes once, sometimes twice, roasted, iron is melted suitable for being re-heated in the smithy furnace, and beaten out beneath that great iron hammer, and cut into pieces with a sharp edge."

One of the latest and most instructive writers on "Early Metallurgy, &c.," Mr. Wm. Gowland, F.S.A., F.C.S. ("Archæologia," vol. lvi, pt. ii, p. 314), considers it as very surprising that "No debris of any furnace, sufficiently perfect to enable us to deduce from it its original form, has yet been unearthed," among the extensive remains of the iron industry during the Roman occupation of Britain. In forming the opinion that in these early furnaces "the metal was never melted, but was always obtained in the form of a solid mass of malleable iron," the authorities have overlooked the fact that, from the impure clay-iron-stone ores smelted in such enormous quantities in Sussex during the Roman period, it would have been impracticable to extract soft malleable iron suitable for forging at a single heat.

The discoveries at Wilderspool confirm Wright's surmise ("The Celt, the Roman and the Saxon," p. 292), that the Roman smelting furnace was "a wall and covering of clay, with holes in

the bottom for letting in the draught, and allowing the metal to run out. For this purpose they were usually placed on sloping ground. Rude bellows were perhaps used, worked by different contrivances."

Mineral coal is also well known to have been in general use throughout the Roman encampments along the line of the walls of Hadrian and Antoninus, and elsewhere. It was certainly employed at Wilderspool for iron-smelting, notwithstanding the oft-repeated assertion that "charcoal was the only fuel used in smelting till 1618, when Lord Dudley introduced coal for this purpose." The fragments of cannel coal found in all parts at Wilderspool have been collected and deposited along with the other relics in the Warrington Museum.

The Romans are well known to have employed bellows, conical ducts, and other artificial modes of creating a blast in their furnaces.

Sir William Fairbairn, in his work on "Iron, its History, &c.," p. 7, points out that "whenever the blast was sufficiently powerful the iron would be fused, and a partial carburation would take place. The resulting metal would undergo a rude process of refining, by which the metal was again heated with charcoal, and the blast directed over its surface, so that the carbon would be burned out, and the iron become tough and malleable. These two processes, he considers, might form two successive stages of one operation, as at present practised with the Catalan forge." The Wilderspool discoveries prove that this is what actually took place.

WARRINGTON'S ROMAN REMAINS.

VII.

During 1902-3 remains of two sets of ovens and furnaces were uncovered on the east and west sides of the Via at the south end of the new street named Roman-road, Stockton Heath, whereby the Roman method of iron-smelting was clearly displayed and rendered no longer a matter of doubtful hypothesis, as it had been previously to these discoveries.

The ore roasting ovens were come upon at the end of this season (1903), and as they illustrate the preliminary stage of the process, will be first described.

DWELLING OR WORKSHOP.—In this instance the surrounding structures were in better preservation and more complete than any yet found. In lieu of the usual court-yard there was a causeway of small boulders and rubble striking off at right angles from the Via at 394 feet from the Ship Canal and extending 45 feet westward for conveyance of ore and fuel to the ovens and giving access to the adjoining workshops. To the right were solid foundations of an oblong construction, probably a dwelling or workshop, gable ended to the Via, area 60 feet 6 inches by 28 feet.

Commencing at 12 feet from the Via, the north wall extends 56 feet 6 inches from east to west, and the west wall southwards at right angles 28 feet (the whole width of the enclosure). These are merely bases of rough sandstone rubble set in stiff clay, with a flat side of the stone turned outwards, so that the face of the wall is fairly upright, width 2 feet 6 inches, depth 3 feet below the Roman surface, which is 1 foot 3 inches below grass level. At the original surface a projecting foot course of brown clay 4 inches thick and 3 feet 6 inches wide, served as a damp course and prevented percolation of eaves-droppings. Bedded upon the latter towards the front of the building there is a single course of dressed stones, squared on the face and tapering inwards in the usual Roman manner, but without any certain indication whether the wall of the superstructure was con-

solidated with clay or lime mortar (probably clay, which is still found between them in small quantities).

On the south side of the enclosure, instead of a wall, a row of circular foundations for posts or pillars supporting the roof, about 3 feet 6 inches in diameter, 3 feet high, and 8 feet from centre to centre, stand parallel to the north wall and 21 feet from it, which was the clear span of the roof over all. The timbers of the latter were necessarily of great strength, having to support the weight of the hexagonal sandstone flags, fragments of which and of curved ridge tiles covered the floor. In one spot broken roofing flags were lying in a heap a foot thick, five feet wide, and at all angles, mixed with pieces of burnt wood, outside the base of one of the posts, which had suddenly collapsed, the building having evidently been destroyed by fire. Several whole ones, some with iron nails in position, were obtained for the Museum from this ruin.

Another row of five circular bases for pillars, of the same material, but of lighter construction 3 feet in diameter, and 1 foot to 1 foot 6 inches thick, parallel to and 7 feet beyond the first, run a distance of 39 feet from the end of the west wall, after which there is a vacant interval of 23 feet between the last base and the corner stone at the south-east angle of the enclosure. These are apparently foundations for supports of a lean-to verandah with wooden roof or extensions of the rafters of the main building.

The inside was covered with two layers of stiff clay, 4 inches and 3 inches thick respectively, having a layer of 3 inches of sand and gravel between them, and apparently belonging to different periods.

The top floor extended over the whole interior and between the bases of the first row of pillars, unbroken by cross walls, except near the east end, where three large stones stood, 3 feet apart at 8 feet from the end of the north wall and at

WARRINGTON'S ROMAN REMAINS.

right angles to it, in position for supporting the upright posts of a wooden partition. Its surface was reddened by fire (possibly that which destroyed the superstructure) and had two hearths; one circular, 5 feet in diameter, and slightly domed, near the middle of the area; the other square, 2 feet 6 inches each way, and sloping at a steep angle of $8\frac{1}{2}$ inches in 4 feet diagonally towards the interior, up against the eastmost base of the inner row of pillars. Its surface was calcined to a light buff colour, the reason of its scorched condition and peculiar shape not being apparent.

The under floor was of equal extent, but was intersected across the middle of the north side by the L-shaped cavities of two ovens or furnaces and an oblong pit, partly edged with brieks and small slabs of stone, before the mouths of the fire-holes. The dimensions of the two cavities were:—

(1) Eastmost: Long arm, 6ft. 6in. by 1ft. 3in.; short arm, 2ft. 3in. by 1ft. 6in.; depth, 4 $\frac{1}{2}$ in. to 5in., the bottom of the trough having a slight fall towards both exits.

(2) Westmost: Long arm, 7ft. by 1ft. 3in.; short arm, 1ft. 9in. by 1ft.; depth, 4in. to 10in., with rather more slope towards the outlets than the preceding.

(3) Pit or prefurnium, 12ft. from east to west, by 3ft. 6in. on the east and 2ft. on the west side, depth 2ft.

The only associated object likely to indicate the purpose of these ovens is a diminutive melting-pot of white clay, stained here and there by the smoke of the furnace, found beside the mouth of oven (1), but unfortunately empty. Like two others found recently, it has a globular body on a short stem and a flat everted foot and rim (the latter for pouring), height 2 $\frac{1}{2}$ in., diameter of body 1 $\frac{1}{2}$ in. The suggestion may be offered that it was used in the production of Wootz steel, by a process in which it was charged with iron and carbon and after luting with clay, roasted in the oven.

ORE ROASTING OVENS.—Along the opposite side of the Causeway (to the left on entering) 41 feet from the Via, an oblong platform of clay hardened by burning extended 18 feet from east to west by 12 feet, and was continued 6 feet further eastward by rough rubble pitching. On

its west end were three L-shaped depressions (like punch marks on the end of a railway ticket), with continuous floors and connected cavities. The middle cavity was evidenced to be an ore-roasting oven by a nodule of clay-band iron ore, splintered and reddened by heat, retained by a hole in the middle of the hearth at its west end, and by several others in a like condition lying round about. (These may be seen at the Museum).

Its long arm was 6 feet 3 inches from east to west by 10in. to 1ft. 3in.; short arm, 1ft. 8in. by 1ft. 3in. Its depth varied from 3 $\frac{1}{2}$ in to 4in., with a slight fall towards the outlets and a basin-shaped depression at the angle between the arms. The broken edges of an overarched cover were traced along the sides and its fragments filled up the interior.

The remaining cavities were shallow troughs of about half the length (2ft. 6in. and 3ft. 6in. respectively), and 6in. to 1ft. 4 in. wide. That on the left had one opening towards the front of the platform and the other to the middle of the long arm of the oven just described, from which it was divided by a strip of burnt clay forming a sort of bridge. That on the right opened the opposite way, with the lip of one mouth to that of the short arm of the oven and the other mouth towards the south, away from it. The slopes and connections were arranged on a plan to enable the ore to be raked into and out of the oven without removing the fire and to allow continuous working. There was a hearth of flag stones in front of the stoke-hole of the oven, and an ash-blackened layer of soil surrounding the platform.

Thirteen feet south from the preceding and in line with it, at a depth of 3ft. 9in. below the grass and underneath a flag pavement and two clay floors of secondary construction (still unexplored), there was another oblong platform of clay of smaller dimensions, 8ft. 6in. from east to west by 3ft. 10in., enclosing a similar L-shaped cavity of the following dimensions:—

Long arm, 5ft. 6in. by 1ft. to 1ft. 6in.; short arm, 1ft. 2in. by 9 $\frac{1}{2}$ in. to 1ft. (turned southward). The depth increased in the same manner from 4 $\frac{1}{2}$ to 6 $\frac{1}{2}$ inches towards the openings and in the angle, and a calcined nodule of clay-band iron ore embedded in the bottom likewise showed it to be the base of an ore roasting oven.

WARRINGTON'S ROMAN REMAINS.

Midway between the two ovens and bedded to the top in a clay floor of uncertain extent at 1ft. 9in. below the grass-level lay a large stone mortar doubtless for crushing the calcined ore, its dimensions being 2ft. 2in. by 1ft. 9in. by 11in. thick, outside measurement, with an oval hollow 10in. to 11in. across and 7in. deep, rounded at the bottom and worn smooth by pounding. This is rather smaller than the similar mortar unearthed last year (1902) on the opposite side of the Via, to be presently described.

Owing to the shallowness of the excavations on this side the finds were necessarily few, but not less varied than in other parts, fragments of calcined clay-band ore predominating.

COINS.—A silver denarius of Nero, and two second bronze coins corroded.

BRONZE.—Harp-shaped fibula, with moulded collar in the middle of the bow and coiled spring (broken).

IRON.—Large iron knife, with curved blade length $7\frac{1}{2}$ inches, and part of tang. Many iron nails, length about 2 inches.

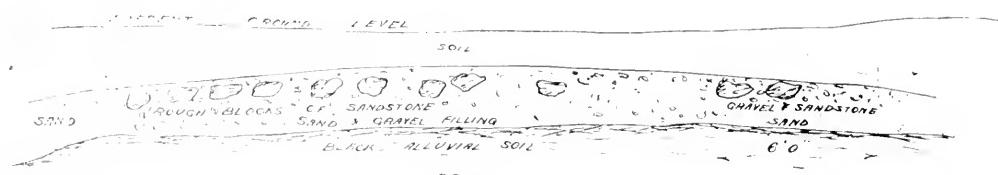
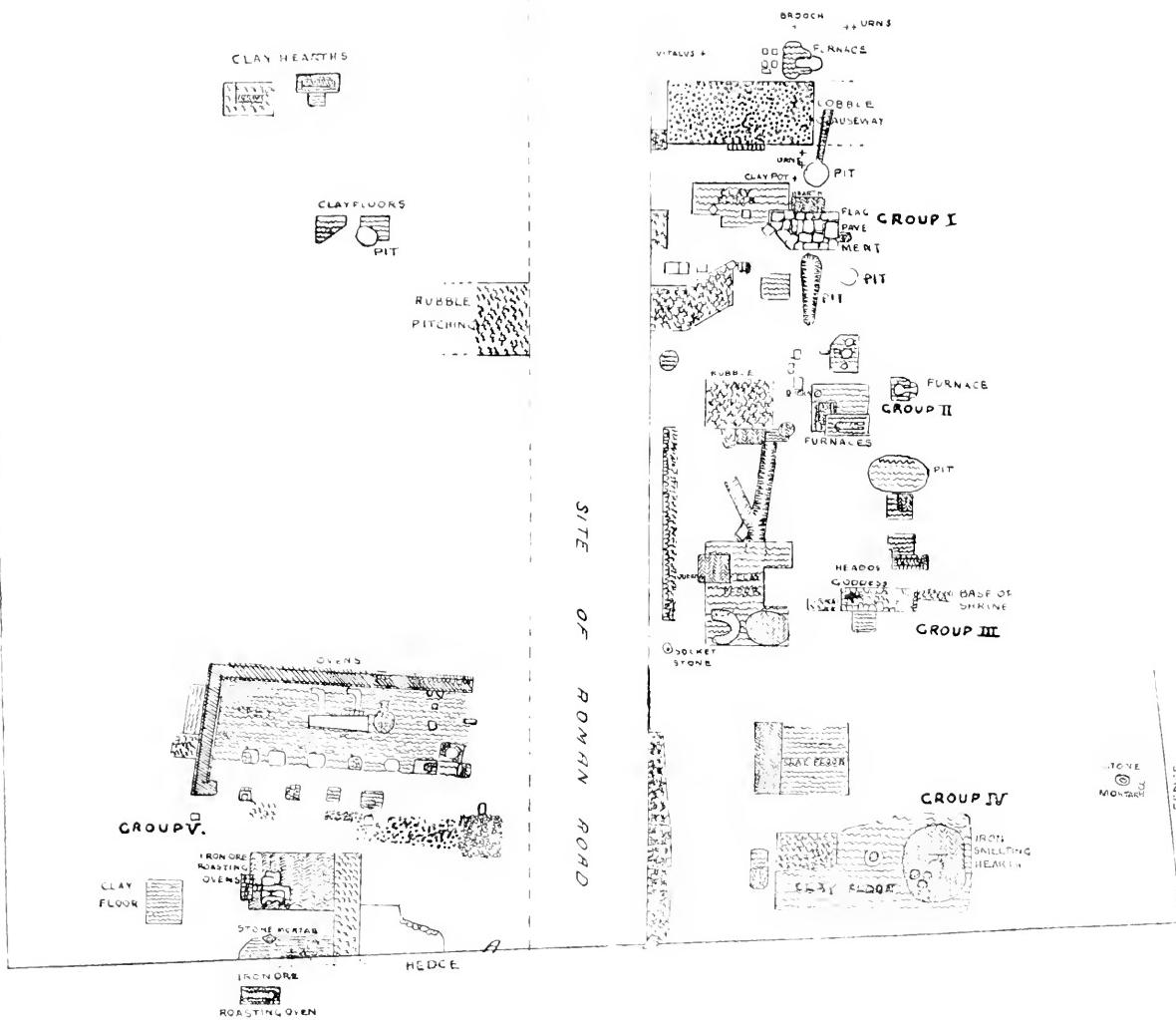
LEAD.—Hollow-sheath for knife or other pointed implement, length $2\frac{3}{4}$ in., with wide mouth and moulded pattern on the outside.

GLASS.—A few fragments of square bottles and flat window glass (dull on one side).

POTTERY.—The potshards were of the usual kinds—black, red, and grey, including several large fragments of finely embossed Samian, and others plain, stamped with the potters' names, SILVINVS FE, BVTRIV, PATERNVS, TIT . . . (outside.)

One fragment of a vessel of common soft red paste has on the outside arched eyebrows, round prominent eyeballs, and nose without mouth, resembling the owl face of Minerva represented so often on the vases and idols dedicated to that goddess found at Mycenæ. (See fig. 1, page 67.)

PLAN II.



SECTION OF ROMAN ROAD ON LINE A-B.

Scale 1 inch = 100 feet

BURNT CLAY

CLAY

RUBBLE

REMAINS OF BUILDINGS, FLOORS, FURNACES, AND SHRINE, &c., AT STOCKTON HEATH.

VIII.

IRON SMELTING FURNACES.—In 1902 an interesting discovery of iron smelting furnaces was made on land leased by Mr. C. W. Davenport, and excavated by his kind permission, situated on the east side of the Via, just opposite to the ore roasting ovens described in part XIII. The traces of workshops started at 22 feet from the Via, and extended 50 feet from east to west by about 57 feet from north to south (starting at 5 feet from the south fence). They included the usual features of a paved court-yard surrounded by clay floors, hearths, rubbish pit, and remains of furnaces, the shape and surroundings of which indicated that, after being calcined and crushed in the opposite ovens (described in part VII.), the clay-band iron ore was mixed with charcoal and smelted into crude or cast-iron on this spot. (See Plan II., Groups IV. and V.)

There were no stone foundations of encircling walls, and it may be inferred that the superstructures were of wood, since they had entirely disappeared, except the fragments of stone flags from the roof and nails for fastening them, which were abundantly met with. But there was a pavement of rough rubble along the edge of the Via in front, 39 feet long by 3 feet to 4 feet 9 inches wide, sloping up from either end to a square platform, 4 feet 6 inches each way, in the middle—like the inclined planes leading up from the pavement to the porch of many of the houses in Pompeii.

The court-yard was 26 feet 9 inches from the Via and 15 feet from the south fence, and compactly paved with rough stones with the smooth side uppermost, bordered on the east side with a straight row of squared sets. Its shape was roughly oblong, the sides measuring—N. 12ft. 6in., S. 13ft. 6in., E. 6ft. 6in., W. 8ft.

A hearth of calcined clay paved with sandstone rubble and amphora shards, measuring 8 feet from north to south by 3 feet 6 inches, was two feet west from the court-yard.

A clay floor, probably that of a dwelling, 20 feet from east to west by 15 feet, and across its west side a clay platform or hearth, 1 foot thick

by 5 feet 9 inches wide, were 6 feet from the north side of the court-yard.

On the remaining sides the court-yard was enclosed by clay floors extending 10 feet southward and 30 feet eastward, giving a total area of about 20 feet from north to south by 40 feet (including the court-yard). The further (eastern) end of this area was covered by an additional floor of very dense clay, oval in shape (diameters 16 feet by 12 feet 6 inches), and slightly domed, in the surface of which the furnace cavities were sunk.

These cavities were three in number, and nearly semi-circular, 2 to 3 feet in diameter, and 6 to 8 inches deep, with sloping bases, like a horse's footprint—so formed to collect the molten metal for ladling. A funnel-shaped sloping trough (2½ inches deep and from 10 inches to 5 inches wide) across the front edge of one of these cavities, at its deepest part, also served for drawing off a lighter liquid, probably slag, and collecting it in a depression purposely provided at its extremity. In the base of one of the cavities was a square hole for a purpose which was not recognized.

Two other features connected with or adjoining the oval smelting floor and not understood are:

(1) An oblong hearth, 4 feet 2 inches by 3 feet 9 inches, of stiff clay 2 inches thick, compactly paved in the middle with amphora shards, inclined at a steep slope of 1 in 11 towards the west, on its west side;

(2) An ornamental hearth of burnt clay (terra-cotta) 1 foot 6 inches in diameter, stamped before baking with a pattern of concentric rings (diams. ½, 1½, 2½, and 3½ inches respectively) fourteen times repeated without intersecting, underneath the middle.

The pit was a small one, 2 feet in diameter, and 6 feet 8 inches deep below grass level, underneath its south side.

The “finds” in the vicinity, though few, are of unmistakable significance, so that “he who runs may read.”

WARRINGTON'S ROMAN REMAINS.

COINS.—Several coins were lying together nearly in line about halfway between the paved court-yard and Via, 2 feet below the grass, viz., five silver denarii (one each of Domitian and Trajan, two of Hadrian, and one corroded), one first bronze of Hadrian, and two second bronze corroded; also at the same spot, five little glass bosses, three black and two white, referred to on page 52.

BRONZE.—Bronze handle in the form of a dog issuing from a calyx, with fore paws extended and joined at the toes to form a loop for suspension—the surface lightly punctured to produce the appearance of texture, length $2\frac{1}{2}$ inches.

A horse's head of similar type and dimensions figured in C. Roach Smith's London catalogue, No. 334, forms the handle of a steel used by butchers for sharpening knives.

Boat-shaped fibula or drop handle in bronze, length 3 inches, a loop at one end and moulded knob at the other. Another, described as a fibula, is figured in Bathurst's Lydney Park Collection, plate XXI., 8, but its use is uncertain.

Flat disc or flan, smooth polished, $1\frac{1}{4}$ inch in diameter, $\frac{1}{2}$ -inch thick.

Small fragment of a ribbed bowl or patera in cast bronze, ornamented with incised rings.

IRON.—Many iron nails 2 to 5 inches in length.

LEAD.—Piece of sheet lead.

VARIOUS.—Round about the smelting floor were 35 lumps of iron slag, and one each of haematite, clay-band ore and reddle; two pieces of ordinary mineral coal and one of cannel; a tool or smoother of cannel, roughly oblong, 2 inches by $1\frac{1}{2}$ inch, by $\frac{3}{4}$ -inch thick, rounded on the edges by wear; stone whorl of fine grey grit, diameter $1\frac{5}{6}$ inch (which was possibly a glass cutter's wheel).

A large stone mortar for pounding ore was met with 2 feet down and 39 feet north-west from the furnaces. The stone itself is roughly hemi-spherical, 2 feet 6 inches across the top,

with the hollow bell-shaped, 10 inches wide by 7 inches deep, the inside of the latter being worn smooth on one side by pounding, and the surface of the stone deeply grooved in one direction by the sharpening of points, a practice which was very prevalent in Roman settlements.

From the number of furnaces and the quantity of ore and slag there can be no doubt that a rude method of iron smelting was practised on this spot. The only question arising is, therefore, which of the many metallurgical processes known to the ancients or still practised by primitive races was employed.

The easiest and simplest, and probably the earliest, method is the before-mentioned "Catalan" process, whereby pure haematite ore is heated a few hours with a charcoal fire in a mere hole in the ground, and a blast from hand bellows, introduced over the top, and maintained until the metal is reduced, when it is forged at a red heat, and without melting.

At Wilderspool two kinds of furnaces existed, viz., a smelting furnace and a purifying or "smithy" furnace, and the shape and solidity of the former suggested that continuous working was practised. (See part V.)

In the shallow cavities now being considered there is no possibility of continuous working, and since impure clay-band ore was chiefly employed, as is clearly proved by the analyses of the slags, this implies that the powdered ore from the opposite ovens was mixed or spread in layers alternately with charcoal, ordinary mineral or cannel coal, inside the cavities, and a blast from bellows introduced over their edges maintained until the mass was actually melted. The slag could then be skimmed or run off through the little trough provided, apparently, for that purpose, as it sloped downwards and narrowed towards the outside, and there was no tap-hole provided for running out the iron from beneath as in modern blast furnaces. The crude or cast-iron could be gathered at the bottom or ladled into moulds, ready for re-heating in a fining or smithy furnace and welding into blooms.

WARRINGTON'S ROMAN REMAINS.

IX.

THE EARLIEST GLASS FURNACES IN BRITAIN.

The unfamiliar and highly technical character of the glassmaker's operations makes it difficult to supply a brief popular description of the evidences of glass manufacture which have been discovered on the site of the Roman oppidum at Wilderspool and Stockton Heath. The study of Roman glass is at the same time a very fascinating one owing to the beauty and variety of the extant specimens, such, for instance, as the Portland vase, which is of cameo glass in two colours, white on a dark blue ground, wherein the effects of light and shade and gracefulness of outline produced with the wheel of the glass-cutter are such as to render it one of the finest, if not the finest, and most valuable work of art that has come down to us from Roman times. The specimens obtained during the last five years for our Museum, though mostly small and fragmentary, are very numerous, and have not only preserved their colour and shape, but have acquired an added beauty, softness, and iridescence from decay, and they all display great technical skill on the part of the workmen. It is a matter for congratulation to our local glassmakers that the earliest glass furnaces in Britain should have been discovered within the borough, and my thanks are due to Mr. Wm. Robinson, of the firm of Messrs. Robinson, Skinner and Co., who still carry on the higher branches of the manufacture, and to Mr. H. Bolton, for permission to visit their works and study their methods. Also at St. Helens, where the extremes of glass making meet, thanks are due for opportunities afforded me of visiting the largest (Messrs. Pilkington's), as well as smallest workshops in the trade, where the local sand is still principally used, as was formerly the case in Warrington, the sand derived from Wilderspool being much purer than it looks and quite suitable for glass making. In the smaller workshops the simple "erib" furnace, a square brick oven with benches for the pots or crucibles,

and Roman methods and materials continue to be employed, while the authorities upon the subject are all agreed that the Romans were familiar with every variety of blown, pressed, crystal, coloured, and cut glass at present known (except the large sheets of polished plate glass), and one of the highest authorities, Mr. Albert Hartshorne, F.S.A. ("Old English Glasses," p. 15) maintains that "since glass making was carried on in a multitude of small furnaces throughout the Roman dominions, there is no reason why the Romans should not have made it in Britain as they made it in Gaul, or why such places as Salene (Sandy in Bedfordshire) were passed unheeded by, and their products not utilized on the spot." This suggestion applies equally to the Roman salt producing station of Salinae (Northwich), only nine miles from Wilderspool, and still more to Wilderspool itself, where glassmakers' sand abounds, and in his letter acknowledging a copy of my last report, Mr. Hartshorne writes: "I am glad I was not mistaken in my conclusions, and that such clear evidences of glass making have been discovered at Wilderspool. I cannot but admire the care and acumen with which these evidences have been brought to light. I am the more gratified because from their nature small Roman glass furnaces are easily obliterated and their sites are so difficult of identification, that I believe the ovens, &c., at Wilderspool, are the only remains of the kind in England."

The number and peculiarity of the glass furnaces uncovered is due to the fact that the Romans used billets of dry wood (beech being preferred as giving most heat and least smoke) without fire bars, the fuel being laid on the floor of the hearth, and the ashes frequently raked out; and to their having followed a double process, whereby the mixed ingredients were first melted together on the bottom of the furnace in lumps, termed ammonitrum by Pliny, or massæ, which were broken with mallets and "dragaded," or melted and poured into cold water in order to improve their quality, and afterwards re-melted

WARRINGTON'S ROMAN REMAINS.

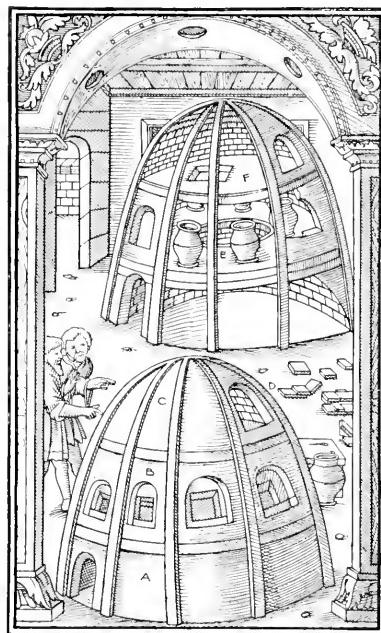
in small pots in the same or some other furnace for the purpose of being worked into shape. Annealing, or gradually cooling to prevent excessive brittleness, was performed in a much longer "arch" or covered passage connected with and closely adjoining the same furnace. The early glass makers also to a greater extent extracted or prepared their own raw materials, instead of purchasing the ingredients in a state of chemical purity ready prepared as at the present day, which involved the use of furnaces (1) for calcining flints, quartz pebbles, tars, &c., and burning sand to render it friable; (2) for heating salt with sulphuric acid to produce salt cake (sulphate of soda), (3) for oxidizing lead to convert it into litharge or minium, and (4) ovens for drying the wood, usually warmed by the spent heat, as they would otherwise consume one-sixth of the weight of fuel for that purpose. These are in addition to the "pot-arch" or glass furnace proper, and the "annealing arch," though in Roman times the same furnace may have been used for different purposes at successive intervals, and the glass furnaces still used in Bohemia and by the famous makers of Murano (Venice), are small and extremely simple ones. Those of the latter are in two divisions arched over from end to end, the working portion being a circular oven about six feet high. The other division, used as a fire or annealing arch and deriving heat through a passage from the former, is straight and about 20 feet in length. The pots, three in number, are set on the floor of the oven, and a fierce fire maintained by relays of boys thrusting billets of dry wood through a narrow slit at the bottom. Before each pot there is a small circular hole through which the pots are charged and the "metal" withdrawn by the workman with his ladle when skimming and sampling, or with the end of his blow pipe for working it into shape.

These furnaces probably resemble the early Roman ones on the same spot, and the workers themselves doubtless derive their art by direct descent from their Roman ancestors.

(See General Plan I., Insula I.)

GLASS MAKER'S WORKSHOP I.—Commencing at the south there are rubble foundations situated at 41 feet from the south fence of the Wilderspool brewery field and one foot from the inside edge of the west Via, near to the row of large

trees, consisting of two main walls (1) with a frontage along the Via of 40 feet from north to south and 5 feet wide; and (2) extending from the north end and at right angles to the latter, 36 feet 6 inches from east to west, and 4 feet wide. In the rear of the front wall (1) there are return walls 2 feet to 3 feet wide, enclosing two chambers measuring 12 feet 6 inches by 12 feet and 12 feet by 8 feet 6 inches respectively; and adjoining the north wall (2) there is



SIXTEENTH CENTURY GLASS FURNACE.

THE ILLUSTRATION IS TAKEN FROM AGRICOLA.

a corridor or passage, 7 feet wide, partly paved with cobbles, extending eastwards to a well, which is situated at 35 feet from the Via and 73 feet from the south fence of the field. From their width these walls were probably constructed entirely of rubble set in clay mixed with sand for mortar, or "raddle and daub" as it is now termed, such structures being mentioned by Vitruvius ii. 8.7, and being quite common in the South of England at the present day, where they are known as "cob walls."

WARRINGTON'S ROMAN REMAINS.

In the rear of this enclosure there is a court-yard paved with cobblestones measuring about 30 feet from north to south by 7 feet 6 inches wide, and beyond this a series of extensive clay floors which were uncovered over an area of fully 30 feet from east to west by 20 feet in the opposite direction, but which could not be completely traced upon the north side owing to the intervention of a large tree.

The shaft of the well above mentioned, which is roughly circular, 3 feet 3 inches by 2 feet 7 inches across, extends to a depth of 10 feet 6 inches below the grass, and is steeined to a depth of 7 feet from the bottom with wedge-shaped stones (*voussoirs*), backed by a pugging of stiff brown clay 1 foot 6 inches thick. Among its contents were a large stone base for a wooden post, measuring 29 by 18 by 16 inches, having a mortice-hole 3 $\frac{1}{2}$ inches square by 3 inches deep on its weathered surface, broken stone roofing flags and iron nails for fastening them, fragments of brick, tile, charcoal, common soft red and black pottery of local manufacture, and a few bits of Samian, decayed teeth of horses and oxen, and a first bronze coin of Trajan in fair condition, the latter found near the top of the well. (See illustration, No. 1, p. 5.)

In the south-east corner of the same floors there is a square pit or well 3 feet 9 inches wide, extending to a depth of 9 feet 6 inches, and steeined with unhewn sandstone blocks to a depth of 5 feet. It contained fragments of similar pottery (including three or four of Samian), teeth of horse and pig, and a part of a lower jaw of the latter, lumps of slag and one bit of ordinary mineral coal, iron nails, and a second bronze coin of Domitian found 3 $\frac{1}{2}$ feet from the bottom.

BASE OF FURNACE.—Closely adjoining the well first described, on the surface of the north-west angle of the floor, an oblong platform of dense clay, 7 feet 6 inches in length from east to west by 5 feet, and 2

feet 4 inches high, was carefully examined and found to enclose an oval cavity 3 feet 6 inches long by 3 feet wide, with a stoke-hole 3 feet long by 8 inches to a foot wide, which were filled with reddened clay and calcined fragments of their overarched covering, and calcined throughout their interior to a considerable depth by intense heat, the bottom floor having been renewed no fewer than eight times with fresh layers of clay from half-an-inch to two inches thick, and the natural sand underneath being whitened to the depth of a foot by the same agency. At the back there was a second opening about ten inches wide for a flue or for charging and discharging the contents. Evidently this was a furnace inside which an enormous amount of heat had been developed, but its intended purpose remained a mystery for two or three years, until its surroundings were more thoroughly examined in 1901 and several fragments of massive (crude half-made) glass, pieces of twisted glass rod, many bits of hollow glass vessels of various shades, two broken clay pots of small size and similar in shape to a whole vessel found last year at Stockton Heath (which was proved on analysis by Mr. Ruddock to contain crude glass), and a lump of partly calcined flint weighing 13 ounces, a material foreign to the district, were discovered in its vicinity. It then became evident that calcining flints of which the clear glass (*crystallinum*) was composed, was one of the purposes for which this furnace was employed; and this conclusion was confirmed by the later discoveries of other furnaces and traces of glass making, including sandiver or scum arising from the impure materials in the glass pots, beads, discs, cut glass, a glass cutter's wheel, socket stone, fragments of more than a gross of different glass vessels and window glass, dull on one side and fire polished on the other, leaden weights for weighing the ingredients, &c., on this portion of the site.

WARRINGTON'S ROMAN REMAINS.

X.

GLASS MAKERS' WORKSHOP II.

In part III. the remains of a flint glass maker's workshop were mentioned as existing in the south-west portion of the Wilderspool brewery field, between the walls of a fortified external annex, outside the principal fortification. These remains were two oblong floors composed partly of "raddle and daub" or mixed clay and sand, situated on the south and north sides of the enclo-ure, measuring:—Southmost (1), 13 feet from north to south by 14 feet; northmost (2), 14 feet from north to south by 11 feet, each of which was crossed from east to west, and partly formed by a massive clay platform surrounding a calcined furnace cavity of more peculiar and elaborate shape than any of the others. The cavities were filled with remains of their overarched coverings, and were concluded to be the bases of glass makers' furnaces for reasons which will be discussed after their structures have been described. Their collapsed condition is accounted for by the shallowness of the surface soil (viz., 6 to 9 inches), of which a portion had been recently removed to the adjoining sand-pit.

1. The southmost cavity resembled a flat-oval earthenware trough with three necks; two outlets running westward to a ring-ornamented hearth of baked clay 3 feet in diameter; the other outlet running in an opposite direction, and being blocked at the end by an upright stone sill. Two of these outlets were directly opposite one another on the east and west sides, and formed a continuous tunnel with the central oval chamber or expansion. The floor of the other opening towards the west was somewhat rounded and resembled the base of a furnace for heating a caldron or melting pot.

DIMENSIONS.

Oval oven I.—Diameters, 4 feet 6 inches by 2 feet; height of upright sides, 10 inches. West outlet: Length, 2 feet; breadth, 1 foot 3 inches. East outlet: Length, 2 feet; breadth, 9 to 10 inches. Base of furnace: Length from east to

west, 2 feet 6 inches; breadth, 1 foot 2 inches to 1 foot 4 inches. The sides of the outlets diminished in height from 10 inches to 1 inch outwards.

2. The cavity of the northmost was shaped like a large earthenware trough with a tap-hole on one side, the neck forming an outlet towards the west opening on to a carefully-laid hearth, 3 feet by 2 feet 6 inches in length and breadth, of flag stones and a single brick (a sesquipedalian, measuring $1\frac{1}{2}$ by one Roman foot, 16 by $11\frac{1}{2}$ by $2\frac{1}{4}$ inches); the side opening gave access to the back of the oven, and terminated in an upright stone sill like the corresponding opening on the east end of the preceding.

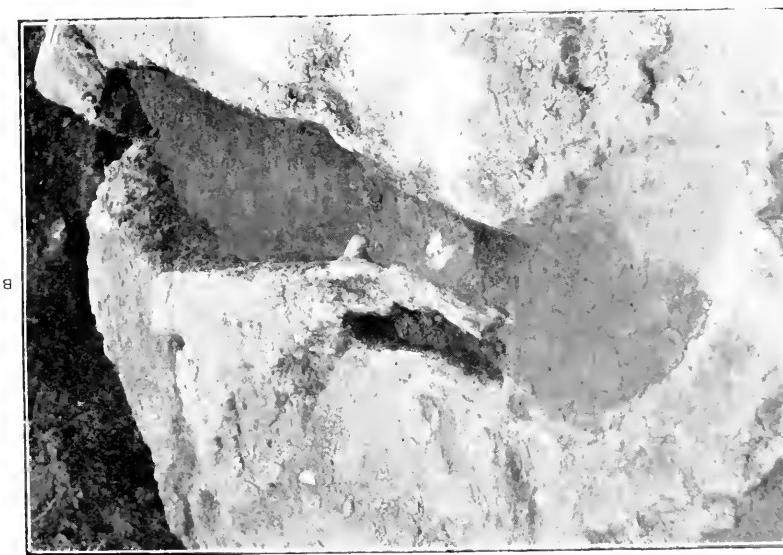
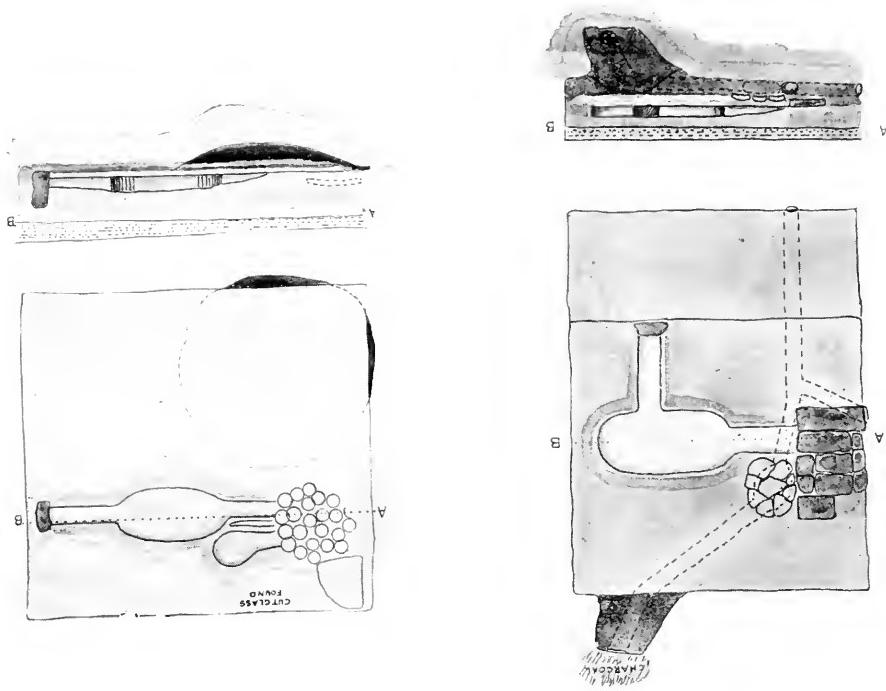
Oval oven II.—Diameters, 5 feet by 2 feet 3 inches; height of upright sides, $4\frac{1}{2}$ inches. West outlet: length, 2 feet; breadth, 10 inches. South outlet: Length, 3 feet; breadth, 10 inches.

Crossing diagonally underneath the floor and platform surrounding the latter (oven II.) was a tubular flue, resembling a rabbit burrow, 6 to 7 inches in diameter, which commenced at a small clay furnace or fire-hole outside the north east angle, and ended in two outlets on either side of the opposite, south-west, angle of the floor, at a total distance of at least 32 feet, the flue being still open and blackened with soot internally throughout its entire length. Near the middle of its length, beside the west outlet of oven II., the flue expanded into a circular chamber about a foot wide, which was covered with fragments of amphoræ, carefully set in stiff clay.

A layer of ash-blackened soil surrounded both hearths, and filled a shallow rubbish pit underneath the south-west corner of floor 1. Further exploration was prevented on the east side by the young trees of the plantation, and on the west side by the old sand-pit.

Fragments of stone roofing flags and two-inch iron nails found in the vicinity showed that the clay floors were covered by some description of strongly built wooden sheds; shards of common red, black, and grey unglazed wares, bright, red,

WARRINGTON'S ROMAN REMAINS.



BASE OF FURNACE AND ANNEALING OVEN WITH RING-MARRED
HEARTH, AT WILDESDROO,

WARRINGTON'S ROMAN REMAINS.

glazed Samian, and a second bronze coin of Trajan, as well as their whole surroundings placed beyond doubt the Roman origin of the remains.

The only objects significant of the intended purpose of the furnace and adjoining ovens were two fragments of crystal cut glass, which were discovered in the substance of the clay platform on the north side of oven I., and another fragment of similar material and ornamentation found near at hand. The ornamentation on

low the rim of a vessel of similar shape and material, but thicker and more deeply incised with an angular projecting cordon and portions of three similar facets. The pattern on the third fragment is formed by deeply cut grooves intersecting diagonally, with intervening cones and ridges, only two of the facets having been smooth-polished, and the others being rough-cut, showing that the vessel was rejected owing to a breakage during the polishing operation, which was being performed near the spot. This



FOR DESCRIPTION SEE TEXT.

these fragments, being specially interesting to students of Roman glass, requires to be minutely described. One of the two first mentioned specimens is a portion of the rim of an upright-sided cup or goblet of clear glass (*crystallinum*) having outside around the brim a plain band about half an inch wide bordered by two half-round cordons, and the upper portions of two pear-shaped and hexagonal facets formed by intersecting circles. The other is a small fragment from be-

description of wheel-cut ornamentation is of a well-known late Roman type, and portions of similar vessels of white glass with cut oval facets found in London and at Birrens are fully illustrated and described by Apsley Pellat (*Curiosities of Glass Making*, p. 136, plate III., fig. 13) and by Dr. Anderson and Mr. James Curle, jun. (*Proc. Soc. Antiq. of Scotland*, 1896, p. 189 et seq.). See above figs. 1, 7, and 3.

The finding of these specimens suggested glass making as the industry in which these two ovens

WARRINGTON'S ROMAN REMAINS.

and furnace were employed, and no trace was found near them of any other industry. The position of the hearths inside the area of the clay floors, and the provision of a separate underground flue for heating purposes beneath the floor of No. II., negative the hypothesis that they correspond to the central pit or chamber of a channelled or composite hypocaust. The most feasible explanation of them appears to be that the small furnace was employed for heating a glass-melting pot, and the adjoining ovens as "lires," into which the newly-fashioned glass vessels, while still hot, were immediately placed, in order to be annealed, i.e., gradually cooled, by being slowly withdrawn from the region of the fire by means of a flat wooden shovel or "peel."

According to the earlier and more primitive methods of annealing, heavy goods intended for cutting were sometimes buried in hot sand before being placed in the "lire," and sometimes the oven was filled with the goods along with burning fuel, and then sealed up with clay and allowed about a week to cool. It will be seen that the long ovens just described were peculiarly adapted for being used in this manner.

Glass makers will understand the necessity for the additional heating furnace and flues underneath the northmost floor (2), to prevent the glass vessels from being chilled and rendered brittle after removal from the "lire," especially in the case of goods intended for cutting.

The glass cutter's wheel already referred

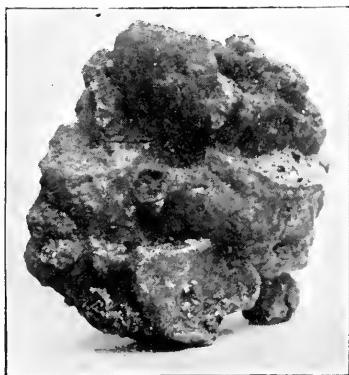
to is a disc of very hard fine-grained grey sandstone, 1 $\frac{1}{2}$ -inch in diameter, $\frac{3}{8}$ -inch thick, $\frac{3}{8}$ -inch bore, which readily cuts glass, and was at once recognized by Mr. Robinson as of finer grit than any now obtainable. Its periphery also fits into the hollow facets on the surface of the two specimens of cut glass above described. It was found with several lumps of scum from the glass pots in a rubbish pit outside the ditch, at 60 feet in a direct line north from the workshop.

Mr. Ruddock's analysis of one of these lumps of "sandiver" of scum gave the following results:

Alumina, with a little iron	10.00
Copper oxide .....	.48
Organic matter and water	2.30
Silicate of alumina and a little alkali	85.67
	—
	98.45

It contained a little free copper, which was perhaps added to colour the glass, and from its appearance and purity it was considered by him to be glass waste.

Though no portion of the glass melting-pot was discovered on this spot during the recent excavations, Mr. J. Paul Rylands, F.S.A., who has collected objects from the adjoining sand pits and interested himself in these discoveries for many years, in discussing the above suggestion, writes:—"In 1869-70 I had 16 plates drawn in water colours of objects found at that time at Longbank, Wielderspool; some of these objects then in the collection of the late Dr. Kendrick and the rest in my own collection, afterwards incorporated in that of Dr. Kendrick. These coloured plates are now before me. Among the objects thus illustrated are two which seem to me to suggest that there was a Roman manufactory of coloured glass at Wielderspool; one of these is a piece of molten glass—green, blue, and white, and the other appears to be a fragment of a large crucible of buff-coloured material, having on one side (part of the interior of the crucible) a thin deposit of glaze of two colours—lapis lazuli and golden yellow. Although it is nearly 30 years since I had this fragment in my hand, I well remember it on account of the importance I attached to its discovery."



A LUMP OF GLASSY SLAG OR SCUM.

WARRINGTON'S ROMAN REMAINS.

This fragment of crucible is from $\frac{1}{2}$ -inch to $\frac{3}{8}$ -inch thick, and the above letter supplies the only missing link in the chain of evidence required for proving the existence of a Roman glass manufactory at Wilderspool. The

raw materials, the melting furnaces and crucibles, the finished and unfinished specimens, and waste, have all been traced and recorded, and the photographs, drawings and portable objects deposited in the Warrington Museum.

WARRINGTON'S ROMAN REMAINS.

XI.

GLASS MAKERS' WORKSHOP III.—Near the middle of the north side of the main fortification and brewery field, 5 to 10 feet south from the eastward extension of the *Via* along the bank of the river, the remains of another glass makers' workshop, with two more curious pairs of furnaces of smaller size than the preceding, and evidently used in the manufacture of beads, were uncovered. The unshaped rubble foundations of two walls 13 feet apart ran parallel from north to south, but there were no traces of gable-end walls, which were probably constructed of timber frames filled in with "wattle and daub" and had entirely perished. The west wall was 20 feet long, 5 to 6 feet wide, and 2 to 3 feet high at 2 feet below the grass. The east wall was shallower and only 6 to 8 inches from the surface; its length was 23 feet and width 2 feet. The former was bedded on a layer of stiff brown clay, and both walls appear to have been consolidated with "raddle and daub" (clay mixed with sand) without lime mortar. The whole of this enclosure was paved with sandstone blocks, under which was an earlier floor of dense clay 2 or 3 inches thick, with a

calcined hearth upon its surface near the middle of the west side.

Beyond these foundations on the east side there were also double floors of clay with a 4-inch layer of sand and gravel between them. The "white hearth" and iron smelting furnace described in Part VI. were met with on the upper floor, which was evidently of later date than the one beneath.

The lower and earlier floor was a 4-inch layer of hard clay at the level of the two platforms in which the glass makers' furnaces were enclosed, and extended about 20 feet from east to west by 10 feet, between and on the south side of the platforms and furnaces.

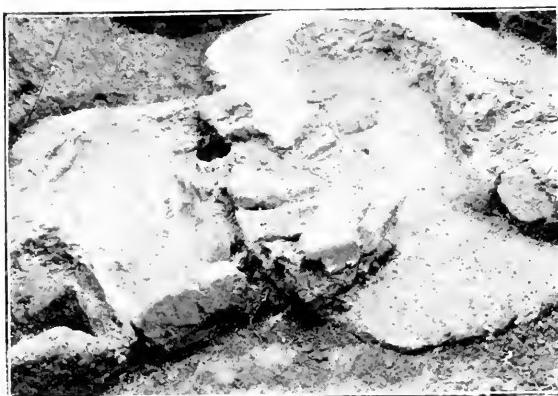
The interval between the foundations, floors and *Via* was partly covered by a cobblestone pavement measuring 15 feet from east to west by 3 feet.

One of the platforms was just inside the north-east angle of the building; the other, 8 feet from it eastward in nearly a direct line. Both were built up of well-puddled clay on a single layer of sandstone rubble or cobbles, and were large enough to provide all round and be-



SUPPOSED GLASS FURNACES, SOCKET AND SHARPENING STONES,
WILDESPPOOL, WARRINGTON.

WARRINGTON'S ROMAN REMAINS.



PAIR OF SUPPOSED GLASS FURNACES, WILDERSPOOL,
NEAR WARRINGTON.

tween the two adjoining furnaces a wall of clay 6 inches to a foot thick. Each furnace had also a hearth of burnt clay (*terra cotta*) round the mouth of the stoke-hole, laid evenly with the floor of the latter, and with a slight batter outwards to facilitate removal of the ashes.

The following are the interior dimensions of the furnaces and the stokeholes leading from them:—

WEST PLATFORM III.

Furnaces.	Stoke-holes.			Depth below
	Height of upright	Breadth. sides.	Length. ft.in.	surface of top of plat-
Furnace 5....3 8 ... 2 6 ... 0 5 ... 0 3 ... 1 8 ... 1 6				
," 6....2 4 ... 1 4 ... 0 6 ... 1 6 ... 1 0 ... 1 6				

EAST PLATFORM IV.

," 7....1 8 ... square 0 8 ... stone slab ... 2 9				
," 8....3 0 ... 1 10... 1 4 ... 1 11.1 1 to 1 8.2 0				

The enclosed furnace (5) in platform III, resembled the base of an ordinary oven. From the thickness and red colour of the superincumbent mass of clay and quantity of calcined fragments inside the cavity, it was inferred to have been overarched. The adjoining furnace (6) seems to have been used for heating a glass melting-pot. The same hearth was continued in front of both their openings with a gradual slope to the edge of the clay floor on the north

side, where was the ash-blackened layer of soil impregnated with many objects of Romano-British origin specified in describing the iron furnaces in Part VI.

The furnace cavities in Platform IV, likewise differed in shape and intended purpose. One furnace (7) was lower and shallower than the other and nearly square, and had two upright stone flags, 7 inches high, half buried in the clay, across the mouth. Lying upon the bottom, beneath the clay from the broken down cover with which it was choked, there was a lump of chalk weighing about 1lb. As this is a material nowhere found in the district it must have been imported for a special purpose, and suggests that one of the uses for which the furnace was employed was for burning the chalk to produce lime, one of the ingredients employed by the Romans for making glass. The long oval shape of the adjoining furnace (8) showed that it was not the seat of a circular caldron or melting-pot, and a mass of red plastic clay with which the interior was choked, numerous fragments of vitrified clay in contact with the base, and a ring of soft clay exposed round its upper margin, where the calcined interior lining had been broken away, suggested that it had originally been overarched. Underneath it possessed three separate floors, the lower ones divided by a 2-inch layer of sand and gravel, and the upper

WARRINGTON'S ROMAN REMAINS.

ones by a cavity 1 foot 4 inches square and $2\frac{1}{2}$ inches deep, filled with charcoal. Near the middle of this cavity there were two holes, measuring 7 inches by $1\frac{1}{2}$ inch and 2 inches by $1\frac{1}{4}$ inch, evenly and symmetrically formed, communicating through the floor with the interior of the fire-place; and on one side, by an opening through the clay wall, communicating with the outside. By these openings it was possible to introduce an artificial blast, from a pair of bellows, into the centre of the fire, and it is difficult to conceive any other purpose the holes could have served. The additional layers appear to have been introduced for the purpose of raising the fire level and economizing fuel, and were certainly not for the purpose of patching, the lower ones being complete and unworn. The stoke-hole was steined and originally overarched; it widened outwards, and the hearth in front was fan-shaped, 2 feet 4 inches across.

OBJECTS.—The conclusion that one of these furnaces in each pair was used for burning sand, quartz, lime, salt, &c., and melting the powdered and mixed materials into masses, or as a "pot arch" for re-melting the latter in clay pots for working; and the adjoining furnace as a "fire," into which small finished articles such as beads were introduced while still hot in order to be annealed, is based not only upon their shape and the proximity of the kind of sand which gives to the bulk of the specimens their greenish tinge, but also upon the number, variety, and peculiarities of the glass specimens found in their immediate vicinity. The glass objects are, therefore, of chief importance as indications of the intended purpose of the furnaces and will be first described.

GLASS.—(1) Bead of oblate spheroidal shape, $4\frac{1}{2}$ inches in circumference, or $1\frac{1}{2}$ inch across what may be termed the equator, and $\frac{1}{4}$ -inch through the string-hole—one of the largest beads on record. The body is translucent pale pea-green, encircled by three inlaid rings, about $\frac{1}{4}$ inch wide, one round the middle of cable pattern, pale blue and bluish white strands alternating, the other two at the intermediate zones of opaque white. It was found only 3 feet 6 inches south from Platform III., at a depth of 1 foot 6 inches below the grass. A slight projecting edge round one end of the string-hole indicates that it has never been threaded, and

that it was probably made upon the spot. A smaller but similarly shaped and ornamented bead, with red, white, and blue strands alternating in the encircling cable was found in the camp at South Shields. See fig. 12, p. 42.

(2) Melon-shaped ribbed bead of grey vitreous paste coated with blue glaze, $\frac{3}{4}$ -inch in diameter, $\frac{1}{4}$ -inch bore; and broken half of a similar bead. See fig. 9, p. 42.

(3) Small tubular bead or bugle of dark green opaque, $\frac{3}{8}$ -inch in length, $\frac{1}{4}$ -inch in diameter. See fig. 8, p. 42.

(4) Plano-convex disc of black paste, like obsidian, $\frac{3}{4}$ -inch in diameter, $\frac{1}{4}$ -inch thick. This is not a solitary specimen, half-a-dozen similar objects, three in black and three in white glass paste, and a small clay pot containing material for black ones, having been found at Stockton Heath. See fig. 2, p. 42.

(5) Fragment about 2 inches in length and $\frac{1}{4}$ -inch in diameter of crystal glass rod, formed of two twisted strands like a cord, found near to the large bead (1) at a depth of 3 feet below the grass. A similar fragment, $\frac{3}{8}$ -inch in length, each strand enclosing a thread of opaque white, was found near to the supposed flint calcining furnace in the rear of Glass Makers' Workshop I., above described.

These curious glass rods, when complete, vary from 7 inches to a foot in length, and from $\frac{1}{4}$ to $\frac{3}{8}$ -inch in diameter, and have a little flat handle or ring for suspension at one end and a small cap at the other. Their use is uncertain, some authorities regarding them as the wands (trudes) in the form of cords bestowed on liberated slaves or retired gladiators (rude donati). By others they are described as "rouge sticks" used by Roman ladies in performance of their toilette.* On the other hand one lady writer, M. A. Wallace-Dunlop ("Glass in the Old World," p. 172), thinks it more likely they were used "for mixing sweet drinks," and such articles were more needful when honey was used for sweetening than at the present day. Articles of similar shape in glass and white metal, termed crushers or stirring mulls, are still used for sweetened toddy instead of spoons by innkeepers throughout the North of England.

* Die Antiken Glaser zu Koeln (Kisa), p. 130, Pl. XVI., figs. 130, 131.

WARRINGTON'S ROMAN REMAINS.

(6) A triangular fragment ($1\frac{1}{2}$ by 1 by $\frac{3}{4}$ -inch sides) of very thin clear glass with the letters AL in relief on one side and indented on the other, evidently blown in a mould. It apparently forms part of the word VALE inscribed over the defeated competitors on one of those "rare and curious" chariot race cups representing scenes from the circus which are fully described and illustrated in C. R. Smith's "Roman London" and "Catalogue of London Antiquities," p. 48, in "The Celt, the Roman, and the Saxon," p. 285, and in "Old English Glasses," p. 11, by Mr. Albert Hartshorne, F.S.A. The latter, along with the Belgian authority Schuermans, considers the balance of evidence in favour of England as their place of origin, and of their date being rather in the second than the first century. See fig. 11, p. 42.

(7) Fragment from the rim of a patera, $\frac{1}{4}$ -inch thick, of pale pea-green translucent glass in a "dragaded" condition, i.e., cracked by being poured when molten into cold water.

(8) Triangular fragment of dull olive green from the side of a globular vessel.

(9) Three amorphous lumps, partly fractured and partly fire polished, and evidently broken from massæ and not from any kind of vessels, viz., 1oz. of common greenish tinted, 1oz. of milky white, and $\frac{1}{2}$ oz. of clear transparent (crystallinum). See figs. 6 and 10, p. 42.

(10) A small bit of opaque cobalt blue enamel or frit. There were also several fragments about $\frac{1}{4}$ -inch thick of square bottles of common greenish-tinted impure material, having moulded patterns of concentric rings on those forming portions of the base; and others of thinner substance from the sides of globular vessels of the same and of pure crystalline material. The square bottles referred to are those so often met with and employed as cinerary urns in Roman cemeteries, but the fragments found at this spot more resembled "cullet" (glass makers' waste) no two being alike or belonging to the same vessel.

In recording these glass specimens it should be recalled to mind that a melon-shaped ribbed bead of cobalt blue translucent glass $\frac{3}{4}$ -inch in diameter, was found in the foundations of a house on the east side of the floor; and that an "aggry" or "sun" bead of inlaid glass, belonging to the Kendrick collection, found at

Wilderspool during a former generation, was made the subject of a learned paper read before the British Archaeological Association by Mr. J. Syer Cuming, F.S.A., and printed in the Transactions, vol. xvii., p. 59. They were referred to as "conspicuous, important, and puzzling antiquities," which in former times were believed to be possessed of mystic and healing properties, being known as "Druid's beads," "adder's eggs," &c. The mystery of their origin has been explained by the discovery of these glass furnaces. See fig. 14, p. 79.

The following is a list of miscellaneous objects found in their vicinity:—

COINS.—(1) A silver "consular" denarius of Augustus (C. Octavius), damaged by heat, but identified by Mr. Barclay V. Head, F.S.A., of the British Museum, and described thus:—Obv., Head of Venus to r. Rev., Octavius in military costume marching to l, his right arm extended and holding a spear in his left, CAESAR DIVIV; found at 1 foot 10 inches below the present surface.

(2) A second bronze coin of Trajan, blackened by iron, but otherwise in an almost perfect condition: Obv., radiated bust of emperor to r., IMP. NERV. TRAIANO AUG. GER. DAC. COS. VIII. Rev., draped female figure standing front, holding a cornucopia in left and a pair of scales in extended right; SPQR. OPTIMO PRINCIPI, SC in field; along with (3) a fragment of an embossed Samian upright sided bowl with Minerva armed in fine relief, found at depths of 2 feet 4 inches and 2 feet 6 inches respectively, underneath the floor.

(4) A much corroded second bronze coin of Trajan, legend undecipherable.

(5) A plain bronze ring, $\frac{1}{2}$ -inch opening $\frac{1}{8}$ -inch thick.

(6) An amorphous lump of copper 1 $\frac{1}{2}$ oz. in weight.

(7) Two squarish lumps of lead and several strips of sheet lead, $3\frac{1}{2}$ to 4 inches in length by about $\frac{1}{4}$ -inch in width, and 1-16th inch in thickness.

(8) Three leaden weights (a) spheroid marked XIII. by slightly indented lines and weighing 7lb. 14 $\frac{1}{2}$ oz., including the corroded remains of an iron ring and staple. (b) Disc., weighing

WARRINGTON'S ROMAN REMAINS.

8½ ounces avoirdupois or about 9 Roman ounces, and probably an example of the dodrana, ¾ libra, (e) disc marked 2 for semis, or ½ libra and weighing 2573 grains. More than a dozen leaden weights have been found at Wilderspool, and their use in making up prescriptions of various materials for different kinds of glass (or "batch" as it is termed) will be readily understood.

In the vicinity of these double furnaces there was also found a very hard socket-stone, with

a hole about ¾-inch in diameter and depth, worn by an upright iron pivot, on the top end of which a glass-cutters' wheel may have spun horizontally, the fly wheel being a large wooden one placed low down on the spindle and worked by the feet pressed against the spokes. See illustration on page 45, background.

In addition to the above there were several fragments of lava querns much decomposed by lying beneath the soil.

WARRINGTON'S ROMAN REMAINS.

XII.

GLASS MAKERS' WORKSHOP IV.—The evidences of glass making discovered last year (1902) on the Stockton Heath portion of the site were less extensive, but quite as definite as those previously described. The remains of workshops were on the east side of the Via (and new street marked "Roman-road") and on the south side of the cobble causeway mentioned in Part I, striking off eastwards at right angles from the former at 80 yards from the Manchester Ship Canal.

The northmost consisted of a group of clay floors, hearths and rubbish pits surrounding a flag pavement which was probably the floor of a central court-yard or impluvium, on to which opened several timber-frame huts or wooden sheds. Portions of the stone roofing-flags and nails for fastening them were met with, but no traces of encircling walls. It may be assumed that the clay floors, which become soft and sticky and easily destroyed when exposed to the weather, were always covered in, and that for open spaces stone flags and pitching were usually employed. (See Plan II., Group I., p. 34.)

The pavement was of large slabs, 4 to 6 inches thick, roughly split and broken with a hammer, the wide joints being filled in with rubble. It measured 14 feet 6 inches on N., 9 feet on S., 8 feet on E., 3 feet 6 inches on W., and 7 feet on S.W., where an angle was cut off in a straight line, and was situated at 25 feet east from the Via and 14 feet south from the cobble causeway above referred to.

On its S.W. angle was set a roughly squared sandstone block, measuring about 2 feet square by 1 foot 1 inch thick, which may have served as a work bench, or as the support for an anvil, beneath which, on the surface of the pavement, were found a second bronze coin of Domitian, and an unworn melon-shaped ribbed bead of the description common to most Roman settlements.

An extensive clay floor, 3 inches thick, enclosed the pavement on the north and west

sides, and extended westward to form the cover of a rubbish pit, its complete plan being, therefore, T-shaped, and dimensions about 20 feet from east to west by 10 feet.

There was a clay hearth, reddened by heat, measuring 7 feet from east to west by 3 feet, adjoining the middle of the north side of the pavement, and on its east side a smaller semi-circular hearth, 2 feet in diameter.

The rubbish pits, four in number, were on the N., S., N.W., and S.E., the one on the south being in the form of a trench, 14 feet long and 3 to 5 feet wide; and that on the north 5 feet in diameter and 7 feet in depth below the natural surface, having a trench or drain leading northwards in the direction of the slope, 11 feet long and from 1 foot to 2 feet 2 inches wide.

On the opposite (north) side of the cobble causeway there was a massive irregularly shaped clay platform enclosing a furnace cavity and stoke-hole of long oval shape, 3 feet 10 inches in length by 2 feet in width, and 9 inches in height, with calcined lining, and stone jambs of stoke-hole remaining, but on one side forced out of place. There was no opening to give access to the rear of the furnace.

It was assumed to belong to the same group as there were no other structures nearer to it, and no other furnace in the vicinity of the latter.

GLASS MAKERS' WORKSHOP V.—At 28 feet south from the flag pavement last described there was a rubble pavement of large area, 14 feet from east to west by 10 feet, also probably forming the floor of a central court-yard surrounded by wooden sheds, and on its east side a group of two clay floors, several hearths, and a large covered rubbish pit. (Id. Group II., p. 34.)

The larger of the clay floors, measuring 11 feet 6 inches from east to west by 10 feet 6 inches, was 8 feet east from the rubble pavement, and had on its surface, partly overlying one another at right angles, the clay platforms

WARRINGTON'S ROMAN REMAINS.

which enclosed two long reverberatory furnaces. The sides of both furnaces were entirely broken down, but the stone jambs lining the stoke-hole of the top one were in position, and their inside dimensions were found from the calcined bases to be about 5 feet by 2 feet in length and breadth.

At 4 feet east from the latter there was an unusually large and massive clay platform enclosing a more perfectly preserved circular furnace cavity 8 inches deep and 2 feet in diameter, the stoke-hole leading from it being one foot long and wide and a hearth in front of the latter 2 feet 6 inches by 1 foot 4 inches. The calcined skin covering the hearth and the interior was about half-an-inch thick, and it was probably used for heating a caldron or melting pot.

The rubbish pit was near to the south-east corner of the clay floor above-mentioned; the smaller clay floor was on its north side, the dimensions of the latter being 8 feet from north to south by 6 feet.

There were three small circular hearths closely adjoining one another along the middle of the length of the smaller floor; and two others of oblong shape bordered by stone sets upon the south side of the rubble pavement. Between the latter and the adjoining floor there were also two or three patches of clay, calcined on the surface and reddened by heat to a depth of several inches underneath, which appeared to be the bases of sow-kilns, or possibly the hearths of huts occupied by labourers, who were in the condition of slaves beneath the Roman sway.

There was the usual ash-blackened layer surrounding the floors and furnaces, and the whole of the soil to a depth of from one to four and even five feet below the grass was impregnated with fragments of black, red, and grey unglazed pottery, and occasional pieces of bright red Samian ware. Many lumps of scoriae or slag were also collected from the lowest portion of the Roman stratum. From the character of the structures it must already appear evident that some kind of industry involving the use of furnaces and a large amount of heat was once in progress upon the spot. What that industry was remains to be determined by a closer examination of the finds.

COINS.—There were two coins, in addition to

the one above-mentioned, viz., a second bronze coin of the Higher Empire, much corroded, found underneath the flag pavement; and one of Constantine the Great found on the surface of one of the detached hearths—the latter in fair condition.

BRONZE.—Penannular ring brooch, $1\frac{1}{4}$ inch across, with part of pin attached. Portion of a mirror smooth polished on one side, $2\frac{1}{2}$ by 2 inches.

Boss of thin hammered material (broken by the spade and partly restored), $1\frac{3}{4}$ inch in diameter, 3-8 inch deep, with a flat rim $\frac{1}{4}$ inch wide and rivet-hole 3-10 inch in diameter.

IRON.—Iron rod or poker $12\frac{1}{2}$ inches in length. Square blunt ended soldering bolt with tapering haft, length $7\frac{1}{4}$ inches.

Auger with point $\frac{1}{4}$ inch wide and butt end of square section, length $1\frac{1}{4}$ inches.

Socketed spear-head, blade 2 inches long by $1\frac{1}{4}$ inch wide, total length 5 inches.

Spoke-shave, blade $3\frac{1}{2}$ inches by 5-8 inch, with nail heads in the fastening plates, total length $4\frac{1}{4}$ inches.

Curved knife blade, length $3\frac{1}{4}$ inches, width 7-8 inch, with portion of socketed handle. Knife-blade broken, length $1\frac{1}{2}$ inches, width $1\frac{1}{4}$ to $1\frac{3}{4}$ inches.

Two 10-inch nails and many others of about 2 inches.

LEAD.—Spindle whorl, 1 inch in diameter, 3-8 inch bore.

Oblong plate with five nail-holes round the edges and heads of two iron nails in position, length $3\frac{1}{4}$ inches, width 2 inches, thickness 1-8 inch.

Smaller plate, weighing $2\frac{1}{2}$ ounces.

Loom weight or plummet, spherical, $1\frac{1}{2}$ inch in diameter, weight 15 ounces, with remains of an iron staple or loop for suspension. (Found at a depth of 4 feet 6 inches, beneath the remains of a wall of regular masonry and later date closely adjoining the Via).

One or two pieces of rod and sheet lead.

GLASS.—Two melon-shaped ribbed beads of grey vitreous paste coated with blue glaze (in addition to the one above mentioned), diameters about 1 inch. One of these specimens is distorted and unworn; the other is worn round the string hole by the friction of other beads.

WARRINGTON'S ROMAN REMAINS.

Three fragments of large square bottles of greenish glass, $\frac{1}{4}$ to $\frac{3}{4}$ inch thick, two having moulded patterns of concentric rings and one plain.

Four fragments of flat window glass, dull on one side and fire-polished on the other.

Single fragments of amber, greenish tinted, and crystalline hollow sided vessels.

Part of the mouth of a bottle of thick bluish green and much decomposed material, $\frac{5}{8}$ inch wide and originally 2 inches across.

POTTERY.—The fragments of common, unglazed ware and Samian, embossed and plain, were as numerous as in other parts. Potter's names stamped inside three of the latter were BITVRIX · F. DONATI · M, and LA . VCIS, with the owner's marks, a trident and O, scratched on the outside beneath the base and X on the inside.

Two large red pans, 8 and $8\frac{1}{2}$ inches high, and very wide across the rim ($10\frac{1}{2}$ and $12\frac{1}{2}$ inches respectively), of local manufacture were found complete close to the south-east angle of the flag pavement at a depth of 3 feet 6 inches below the grass; and a small fragment of a cylindrical perforated object of the same kind of ware, scratched with the letters VITALVS·V previous to baking, was obtained near to the same spot. The name is probably a mistake in spelling the well known Roman one of VITALIS, the tombstone of an armourer belonging to the 20th Legion of that name having been found at Bath, and a centurial stone bearing it at Melandra Castle, near Glossop.

Among miscellaneous objects the following may be mentioned:—

A nether quern stone of coarse grit, slightly conical, $14\frac{1}{2}$ inches in diameter and $1\frac{1}{2}$ to 3 inches thick.

Portions of five querns of lava and coarse grit.

A flat ovoid rubbing stone or polisher of fine, hard smooth grit, diameters 2 inches by $1\frac{1}{4}$ inch by $3\frac{1}{16}$ inch thick.

A rubber or polisher of micaceous sandstone, rounded at one end by wear, length $3\frac{3}{4}$ inches, width $1\frac{1}{4}$ inch, thickness $\frac{1}{2}$ inch.

An oblong burnisher or potter's smoothing tool of cannel, $2\frac{1}{2}$ inches by $2\frac{1}{4}$ inches and $\frac{1}{4}$ inch thick.

Eight pieces of mineral coal (principally cannel) of undoubted Roman origin.

Four lumps of clay band iron ore, and one each of reddle and limestone.

Forty-four lumps of iron slag and sandiver or glassmaker's scum.

One of the latter found near to the circular furnace—a vesicular grey mass resembling in colour the paste of the melon-shaped ribbed beads—was analysed by Mr. Ruddock and proved to be a double silicate of alumina and magnesia, its percentage composition being:—

Alumina	...	...	...	...	...	...	...	6.42
Lime	...	...	...	...	...	...	...	3.85
Magnesia	...	...	...	...	...	...	...	8.22
Silicate of Alumina	...	...	...	...	...	...	...	81.32
							—	99.81

This he considered on account of its purity to be glass waste.

A small red clay crucible, $2\frac{1}{2}$ inches high, with a globular body $1\frac{3}{4}$ inch in diameter, and a flat everted rim and foot, containing a hard substance which had been fused into it and could only be withdrawn by breaking the vessel, was found 7 feet north from the flag pavement and 2 feet 2 inches below the grass. A portion of the contents, obtained by scraping or drilling was found on analysis by Mr. Ruddock to contain:—

Ferric oxide	...	...	...	...	...	...	...	9.43
Alumina	...	...	...	...	...	...	...	3.80
Lime and magnesia	...	...	...	...	...	...	...	1.10
Soluble alkalis	...	...	...	...	...	...	...	1.50
Organic matter and water	...	...	...	...	...	...	...	9.10
Insoluble residue (silicate of alumina and a little alkali)	...	...	...	...	...	...	...	75.02
							—	99.95

This from its purity he considered to be "the residue of an attempt to make glass from a mixture that would not fuse." It has been pronounced by an experienced glass manufacturer to be the material of black glass paste, which is very probable, as three plano-convex discs of that kind of material resembling buttons unperforated, and three others of opaque white were found a few yards away. Close by, at

WARRINGTON'S ROMAN REMAINS.

the same level, were silver denarii of Domitian, Trajan, and Hadrian, three others of the same metal in a corroded condition, a first bronze of Hadrian, and second bronze of Trajan, suggesting that the black and white glass discs were used in some game like our "draughts" or checkers, or perhaps even as tokens or small change money. They are $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in diameter and about $\frac{1}{4}$ inch thick in the middle. Flat glass discs of larger size, weighing 68 grains, were used as coin weights for weighing gold solidi or sextulae during the late Byzantine period in Egypt.

MISCELLANEOUS GLASS SPECIMENS.—The following are noteworthy glass specimens found in this locality but not in the immediate vicinity of the workshops.

Small tubular bead or bugle of bright emerald green translucent and very thin material, $\frac{1}{2}$ inch in length and $3\cdot20$ inch in diameter. See fig. 5, p. 42.

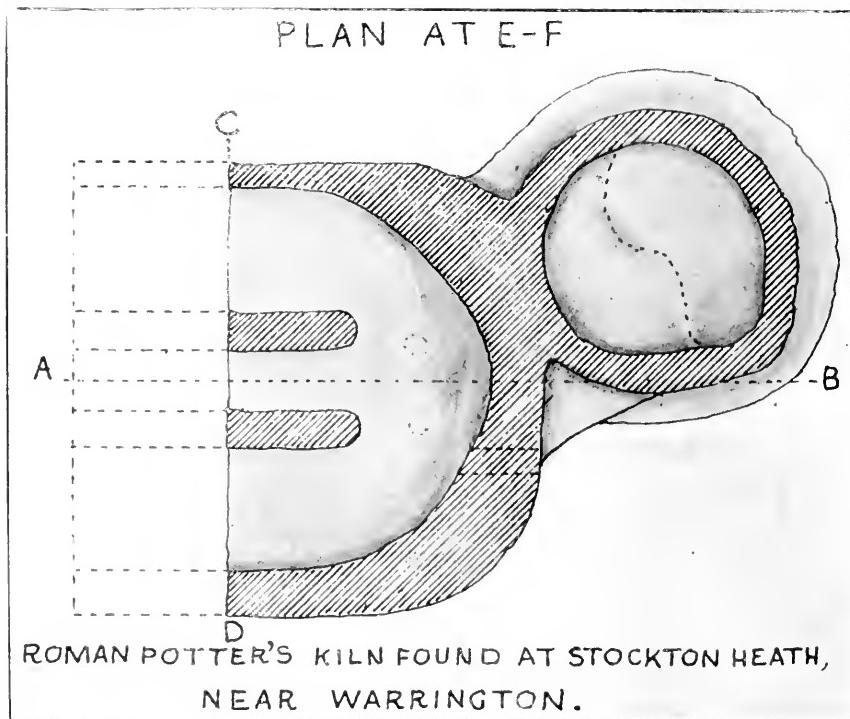
Fragment from the rim of an upright sided

cup or goblet of thin clear crystallinum with a band of finely and evenly etched lines, 24 to the inch, round the outside, a kind of ornamentation, which, with various modifications of depth and direction, pervaded the whole Roman glass industry. This was found along with two second bronze coins, one of Vespasian and the other corroded and undecipherable, on the surface of a clay floor measuring 11 feet 6 inches from north to south by 10 feet, about 1 foot 6 inches below the surface, in the north-west corner of the brewery field and just outside the same angle of the principal fortification.

Several interesting fragments from the everted rims, originally about 2 or 3 inches across, of small globular vases of thin clear glass of various shades.

There are besides several melon-shaped ribbed beads (the provenance of which cannot be exactly specified), several being distorted, broken or unworn, showing they were made near at hand.

WARRINGTON'S ROMAN REMAINS.

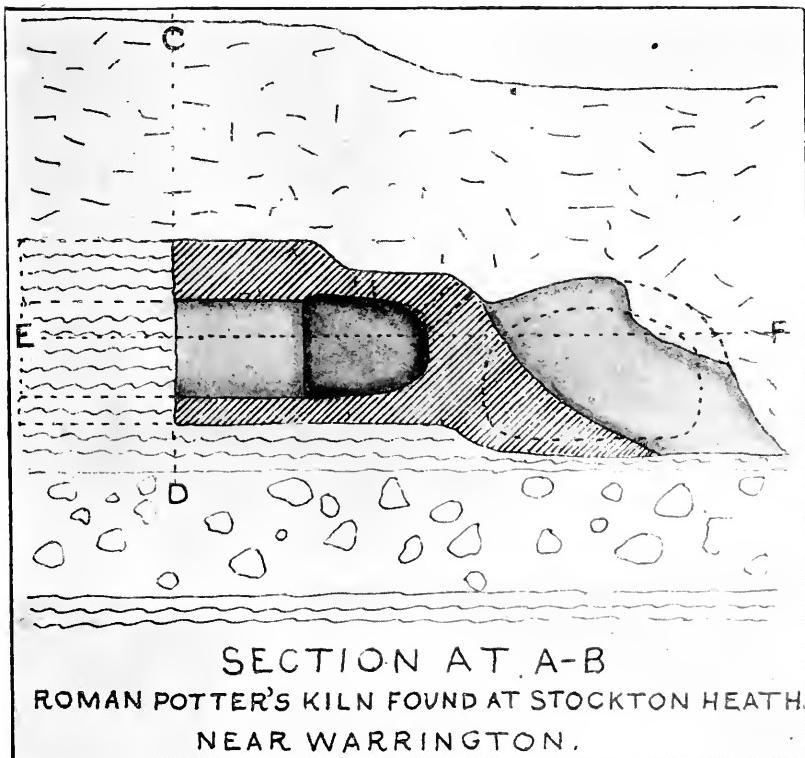


WARRINGTON'S ROMAN REMAINS.

XIII.

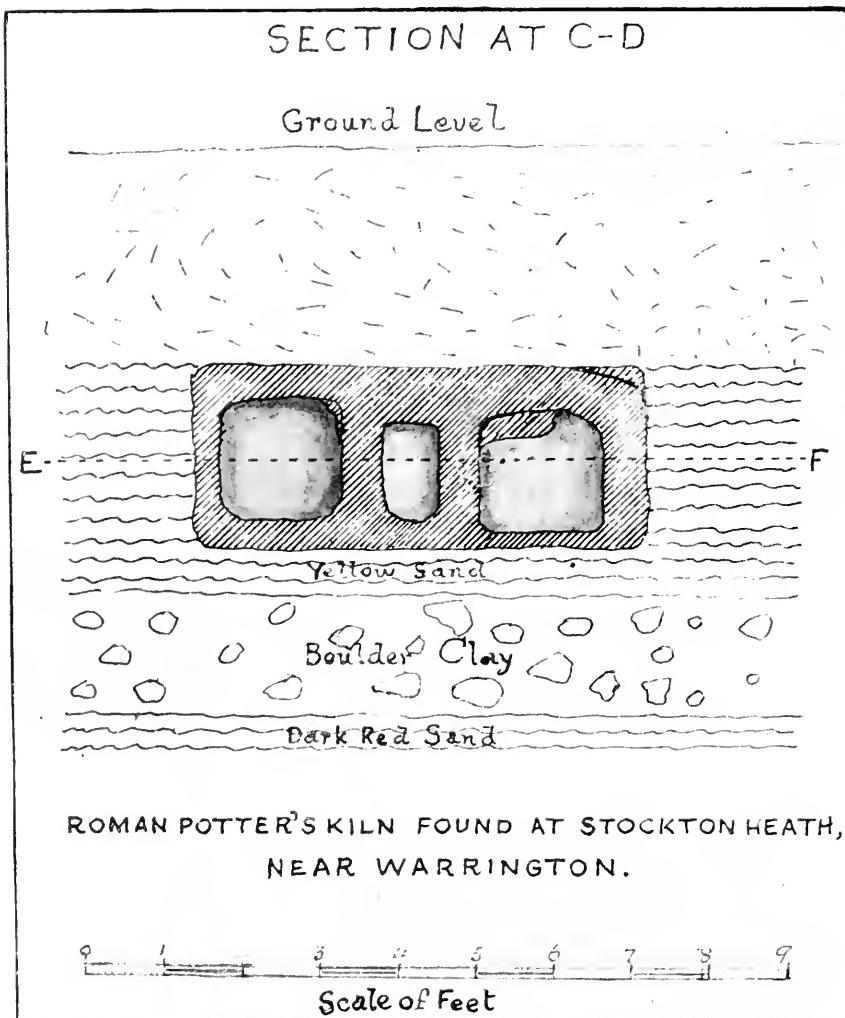
POTTERS' KILNS.—Every day's experience during these excavations has confirmed the truth of Schliemann's observation that "pottery is the cornucopia of archaeological wisdom" since potshards, which are imperishable, are always present in the Roman stratum, are often the only definite remaining trace of Roman occupation, and the only means of identifying structural and other remains as belonging to that occupation. Even when coarse and rude they are valuable as guides to further search and discovery. The so-called Samian, the ordinary table ware of the entire Roman world, possesses a beauty and interest of its own, partly

in its ornamentation as an indication of the degree of advancement in the arts and manufactures of the period to which it belongs, and partly in the potters' names and graffiti marked upon it as showing the nationality, social condition, and learning of the makers and possessors and the particular locality where it was made. It also affords clear proof of the ease and regularity of the means of communication between all parts of the Empire, whereby the widespread distribution of such easily broken ware could alone be rendered possible. To adequately describe the numerous specimens contained in the Museum would involve the preparation of a



SECTION AT A-B
ROMAN POTTER'S KILN FOUND AT STOCKTON HEATH.
NEAR WARRINGTON.

WARRINGTON'S ROMAN REMAINS.



separate well-illustrated treatise and considerable outlay. Only a mere summary of the more important of them can now be attempted.

A brief account of local pottery-kilns will first be given. These are situated together beneath the west side of the new street named Kimberley-drive in Stockton Heath, at a point a little north of its junction with Dundonald-avenue, and quarter of a mile south from the river bank and principal fortification at Wilderspool. They

are the most perfectly preserved of the local remains, and among the most complete and curious of their kind found in Britain.

The earliest discovered, and eastmost, was come upon accidentally in digging a sand-pit on land leased for building purposes and making the new street by Mr. Joseph Twiss, with whose permission it was carefully examined before being covered up. The structure consisted of three furnace cavities united at the back, but

WARRINGTON'S ROMAN REMAINS.

separated in front by two short piers supporting the roof. Thus it resembled in shape the skull of an animal with flat forehead and three apertures opening into a hollow dome-shaped interior, the plan being square in front, and semi-circular behind. The encircling walls were of massive boulder-clay, 3 to 9 inches thick, calcined into terra-cotta and vitrified to a depth of half an inch internally by intense heat. The piers were 4 inches thick and 1 foot 8 inches in length, the extreme length of the interior being 3 feet 4 inches, and the hollow chamber where the fire from the three furnaces was concentrated measured 1 foot 8 inches from front to back. The two outer and larger apertures were about 1 foot 6 inches square on the inside, and the inner and smaller one 1 foot 3 inches high by 9 inches wide. The external dimensions were:—Height, 2 feet to 2 feet 4 inches; width, 5 feet; original length, 6 feet, the front portion having been broken down for about 2 feet, as shown by the red colour of the adjoining sand bed. Evidently the mode of construction was to excavate a hole in the sand of the proper shape of the furnace and to line it with clay, and then, after natural drying, to maintain fires in the interior until the whole was burnt into a hard mass as it was found.

The heat was conveyed through the roof into the kiln, where the vessels were arranged for baking, by two holes $2\frac{1}{2}$ inches in diameter, placed a foot apart at 6 inches from the ends of the two piers; and there was a flue 4 inches in diameter for regulating the draught in the rear of the right hand fire-hole.

Nothing remained of the circular surrounding wall of the kiln but a single block of squared sandstone measuring 1 foot by 10 inches by 3 inches. Six feet from the front of the fire-holes and three feet below the existing surface there was a dense mass of fragments of the soft red unglazed ware, of well-known shapes intended only for useful purposes, ollæ, urcei, lagene, ampulæ, urnæ, patellæ, patinæ, and mortaria or pelves, evidently potters' waste, i.e., broken vessels rejected on account of flaws or distortions, the whole cemented together by soft clay.

A more complete kiln, but beehive-shaped and somewhat oval in plan, was at the left rear and partly conjoined with the furnace above described. The walls were also partly built up

against a hole dug in the sand and of the same material about 8 inches thick, but increasing in thickness downwards to about a foot, to give the structure a firm basis, which rested upon an extensive bed of clay, about 18 inches thick and 6 to 8 feet below the present surface, employed as the material for making the pottery. The external dimensions were:—Height, 3 feet to 3 feet 6 inches, with a slight batter towards the mouth of the fire-hole; diameters, 5 feet by 5 feet 9 inches at the base, the sides curving inwards to about 3 feet across the top.

Access to the kiln for charging was by a hole rather more than 2 feet wide at the top, and the interior was divided into two chambers by a false bottom 3 inches thick, supported by a column in the middle a foot high and from 1 foot 9 inches to 2 feet 3 inches in diameter, thus leaving a fire passage or flue about 8 or 9 inches wide round the sides, communicating with a stoke-hole about 1 foot 3 inches square in front. The upper chamber, where the vessels were baked, was about 2 feet in height and from 2 feet 9 inches to 3 feet 6 inches in diameter, and there were seven or eight holes round its sides through the false bottom (which was partly broken) for admitting the heat, these holes increasing in diameter from two or three inches to about double as they receded from the fire-hole, to cause the heat to be uniformly distributed.

The fuel was entirely of wood laid on the floor of the furnace, which was without fire bars.

The base and partly broken-down sides of another of these beehive-shaped kilns was situated at a distance of only 3 feet 6 inches N.W. from that last described, and was constructed of the same material, and on the same plan. It was also of the same external diameter, 5 feet 9 inches, and must have been of about the same height as the foregoing. The sides of the upper chamber were upstanding to a height of about a foot, and were from 10 inches to a foot thick. The false bottom was 4 inches thick and supported by a central pillar 1 foot 9 inches in diameter, leaving a fire-passage round it a foot wide and from 6 in. to 1 ft 6 in. deep, thus giving a steep slope towards the fire-hole. For admission of heat it was pierced round the edge by seven holes, which gradually increased in size from

WARRINGTON'S ROMAN REMAINS.

3 inches by 2 inches to double those dimensions as they receded from the fire-place, which was on the west side and supported by slabs of sand-stone. The dimensions of the fire-place were:— Height, 1 foot 6 inches; width, 1 foot 8 inches; length from front to back, 2 feet.

A silver denarius of Antoninus Pius, A.D. 138 to 161, with a fine laureated bust of the emperor to right, Obv. ANTONINVS . . . P.P.TR.P.XII,

Rev. a female draped figure standing front, COS III, was found half-way between the two kilns at a depth of 4 feet 6 inches below the grass. Among the mass of broken pottery surrounding them there was also a piece of very hard stone, 5 inches across, which formed the socket of the potters' wheel in the middle of which a hole $\frac{1}{2}$ inch in diameter and $\frac{1}{4}$ inch deep was worn by the rotation of the iron pivot.

XIV.

VERATINE WARE.—Most of the locally made pottery found beside the kilns, and conveniently termed Veratine ware, is of soft brick-red paste, though a drab coloured paste was used more sparingly. Large vessels for ordinary domestic purposes are in the majority, but a large proportion are ornaments—vases and urns of graceful outline and a style and character of their own—as will be seen by examination of the broken specimens obtained from the kilns and the whole or partly restored vessels from all parts of the oppidum in the Museum.

The workmanship is expert and evidently free-hand, no two vessels being exactly alike, but there is the usual settled conformity to Roman ideals in the design and character.

The commonest forms are (1) a small vessel of cinerary urn type, 4 to 6 inches high, thin red soft paste, ovoid body with slightly everted angular or curved rim. The ornamentation, which usually forms a wide band round the bulge with a plain band above and below, is of four kinds:—(a) “Engine turned” or tool-marked patterns lightly indented by a toothed roller upon the soft clay previous to baking; (b) “Rough-cast,” little lumps of clay sprinkled over the surface and fixed by dipping the vessel in a bath of thin slip; (c) “White-washed,” a thin coating of white clay on the surface of the red applied by dipping in a bath of white slip or with a brush; (d) Vertical indentations, made by pressure of the thumb upon the sides at regular intervals while still plastic. “Rough cast” was sometimes added;

(2) Wide mouthed urns, with rounded body and upright rim, “engine turned” and “white-washed,” and with imitation ring handles to resemble bronze situlae;

(3) Triple vases conjoined and communicating by holes in the sides, bodies globular, and “white-washed”;

(4) Small vases, 3 to 4 inches high, nearly upright, with slightly everted rim and foot.

One large vase (partly restored from frag-

ments) of red paste “white-washed,” originally about 14 inches high and 37½ inches in greatest circumference, is specially interesting and may be termed unique. Three cordons of frilled edging (thumb-work) divide the bulge into as many bands, two of which are impressed with a series of bosses about an inch in diameter arranged triangularly, 3, 2, and 1, formed by pressure of the potter’s thumb on the inside against a ring or tube on the outside. The spaces between the triangles are painted lightly with triangles, and treskeles in red ochre. The neck is ornamented with indented and projecting rings and a wavy line made with a point in the soft clay. The contour of the neck and shoulder is graceful, and the edge of the everted rim, which is 5 inches across, has a triple moulding. (See illustration on next page.)

The useful patterns are:—(1) Little pots, 2½ to 3 inches high, bodies globular, with contracted mouth and base, and sometimes a flat everted rim and foot. These are believed to be melting pots;

(2) Flat shallow dishes with upright sides “nipped” handle, and spout for a wick or for pouring, resembling handlamps;

(3) Shallow basins with rounded sides thickened rims and ring bases;

(4) Similar basins with sides curving in two steps or degrees outwards;

(5) Tazza-shaped cups supported by a stem and circular foot, ornamented with frilled edging (thumb-work) round the rims;

(6) Large pans, 8 to 9 inches high and 10 to 12 inches across the mouth, with thick everted rim and conical base. These appear top heavy and are the least graceful of all the locally made specimens;

(7) Jars (*ollae*) with short necks about 2 inches wide, with or without handle, plain, or ornamented with indented or raised rings;

(8) Bottles or narrow necked jars; bodies globular, with or without handles;

Fragments of a few urns, flat pans (*patellæ*)

WARRINGTON'S ROMAN REMAINS.



and mortaria of drab paste have been found among the waste near to the kilns.

(9) Strong shallow pans (mortaria), with wide grooved rim, spout for pouring, and base studded with quartz fragments to resist friction. The paste is always very thick, and dense and sometimes of a dark brown colour through excessive baking. The name of the potter is often stamped across the rim. From the fact that the same name is seldom found in two localities and the names are usually Celtic, very rarely Roman in character, it has been inferred that the potters were natives of the localities where the vessels have been found. ANIACO and ICOTASI (see list No. 5), are names stamped on large fragments from the waste surrounding the kilns; BRICOS and BRVCI occur more than

once on fragments and whole vessels of the same kind of local red ware. These four are, therefore, the names of local potters who carried on their trade at Stockton Heath at some time during the first four centuries of our era.

The names are in rude characters and in two instances read backwards, the user of the stamp being apparently illiterate and unaware that the impression of a stamp is reversed.

CASTOR WARE.—Of the vases and cups of greyish and purplish paste coated with black glaze, ornamented with animals, scrolls, &c., in the characteristic engobe or slip, and supposed from inscriptions upon them, such as "Fill," "Drink," "Good Luck," "Wine," &c., to have been used for convivial purposes, which were manufactured at Castor (Durobrivæ), on the

WARRINGTON'S ROMAN REMAINS.

banks of the Nen in Northamptonshire, many fragments have been collected but are too small in size to be of special interest individually. A few belong to small globular vases of thin hard paste, resembling porcelain in texture and coated with "rough cast."

AMPHORE.—Fragments of great wine jars (*amphoræ*) with two handles and half-an-inch to an inch thick were common enough to be used for paving and other structural purposes. Their chief interest lies in the potters' stamps upon the handles and other inscriptions found upon them, a list of which No. 3 is given.

SAMIAN WARE.—The bright red lustreous ware called Samian, or pseudo-Samian, from its resemblance to that for which the island of Samos was famous about 900 B.C., has been traced by the makers' names (see lists given below) and designs upon it to extensive factories of the Roman period at Lezoux (Puy-de-Dôme, France), Rheinzabern (Rheinbairn), Heiligenberg (near Strasbourg) and Arezzo (in Tuscany), where deposits exist of the fine clay and reddle of which it is composed. It bore embossed figures, and in its manufacture a general mould of the same kind of clay and outline was stamped on the inside with various ornaments before baking; the moist clay was then pressed into it, so that any number of vessels were produced from the same mould and any number of moulds from the same or different stamps.

Eight of these moulds belonging to the Mayer collection in the Liverpool Museum have no provision for a foot-ring which was always added and, being often of dove-tail or double-convex section, could not be withdrawn whole from any mould though made of several parts. The foot-ring must, therefore, have been separately fashioned and fastened to the base, and the whole washed over, by means of a sponge or soft brush, with a thin glaze of reddle, clay, and salt-sulphate of iron, or some other colouring dissolved in water to give it the characteristic gloss.

The shape of these moulds also shows that they were not employed as "seggars" for holding the vessels in the kiln as some have supposed.

The plain vessels appear also to have been moulded.

Ornamented or embossed ware is usually in the form of upright sided urns or hemispherical bowls, and the festoon border is com-

mon to nearly all of them. Portions of shallow dishes (*pateræ*) with ivy leaves or buds and tendrils in relief on the border, but otherwise plain, have been obtained.

The decay of art may be observed in ornamentation produced by worn and blunted stamps or moulds; figures crowded together without cohesion or unity of design—hares, birds, wild animals, nude figures, rings, and cable-mouldings repeated several times on the same vessel—or blurred by careless turning. The earlier vessels (those deepest in the ground) are of harder paste and bear simple, graceful patterns in sharper relief, e.g., the fragment with the figure of Minerva armed; an upright sided bowl (restored) with four principal subjects (Victory, Diana, a slinger, and man in armour), repeated twice, making a band of eight figures; and part of a bowl with a single band of festoons in high relief.

Many other large fragments of embossed urns and hemispherical bowls (some nearly whole) are preserved in the Museum.

The plain vessels are cups (which have received fancy names, *salini*, *acetabuli*), with doubly curved or straight sides widening outwards at two different angles; and saucers (*pateræ*) with wide nearly flat bottoms and straight sloping sides. Some have a wide curved flange round the outside for supporting them on the rim of another vessel.

Many large fragments of such vessels of sufficient size to show their outline, and several nearly whole or restored, have been obtained for the Museum; including part of the base of a mortar studded on the inside with fragments of quartz of the same kind of ware.

A number of fragments have holes bored near the edges, and remains of leaden clamps used for repairing them when broken in Roman times.

Subjoined is a complete list to date, including those in the Kendrick Collection, of potters' names, owners' marks, and other inscriptions on pottery found locally.

The name of the potter when in the nominative is usually followed by *F.*, *fecit*, made; when in the genitive by *M.*, *manu*, by the hand of, or *O.*, *OF.*, *officina*, workshop.

The numbers following the names under the heading of *C. I. L.*, are those in Vols. VII. and XIII. of the *Corpus Inscriptionum Latinarum*

WARRINGTON'S ROMAN REMAINS.

recording other localities in Britain where these names have been met with.

(1) NAMES OF POTTERS STAMPED ON PLAIN

SAMIAN:—

C₄I₃I₄.

ALBINI · M.	... ...	... Vol. VII.	39
ANDEC	Andecatus or Andecus	... ...	65
AM ... CO · F	... ...	... ...
ATTICIM	... ...	... ...	109B
ANAILLIM	Anaillus	Vol. XIII.	115
BELINICCI · M.	thrice	... ...	141
BELATVLLVS F	... ...	... ...
BIHLICCTIM	Bellieus	... ...
BI · T · VR · IX · F	... ...	... ...	159
BORILLVS F	... ...	... ...	167-171
BALITYAF	Battilla	... ...
BVTRIV.	outside	... ...
CHITTVS #1	Cettus Fe	... ...	316
CHRESI and CIRESI M	Chresus	... ...	307
CALLIMAXVS X=ch here as often		... ...	208
CALAVAF	... ...	... ...
F CALVI	Calvus	... ...	217
CALVIO	do.	... ...	219
CALVINIO	... ...	... ...	215
CEREALIM	... ...	... ...	295-301
CELTAS	... ...	... ...	285
CELSICOM	... ...	... ...	283B
COCITPI	Cocillus	... ...	327I
CRACVNA · F	Scratched VII	... ...	358
COCVRO F	... ...	... ...	601
O · C · N · CEL	Officina C. N. Celsi	... ...	192
DATI · M	Datius	... ...	756-7
DECMI · M	... ...	... ...	406
DONATI · MA,	twice	... ...	430-2
ERICI · M	... ...	... ...
EDA or HEDA	... ...	... ...
OF FRONTINI	... ...	... ...	468
FELIC	Felix	... ...	448
OF FLAVII GER	Officina Flavii Ger-		
mani	... ...	... Vol. XIII.	461II
FVSCI	... ...	... Vol. XIII.	471II
IVLIMA	... ...	... ...	523
FILVIRA	Ilvira feit	... ...

						c.l.
LLINIM	Jullini M	...	...	...	...	1083
LVPP	Luppa	...	...	...	...	582
LA . TVCIS	Lastuea	...	...	...	...
LIITERAE...	...	...	...	...	...
OF. L·X	...	...	...	...	...
MACCALIM	...	...	...	...	...	590
MARCELLIM	...	...	...	Vol. XIII.	1636	
.. MATE	Of. Mate	...	...	...	...	681
MAXMIIM	Maximinus	...	...	...	...	686
METTI·M	...	...	...	...	...	1350
MACRINIM...	...	...	...	...	...	603-4
MANV	Manus Fecit	...	...	...	...
MICCI·V	Miceus	...	...	...	...	707
NICANH	...	...	...	...	...
... CEPHOR	Nicephorus	...	...	...	...	758
PAVLII	Paulhus	...	...	...	...	816A
PATERCLINI OF	...	...	...	...	...	791
PECVLIAR	Peculiaris	...	...	...	...	824
RHOGENI	Ritogeni or Reoeeni	...	...	...	...	922-3
SACRAPO·F	...	...	...	...	...	974
SEVERI·M.	twice ..	...	...	...	...	1047
OF SILVINI	...	...	...	...	...	1069
SILVINVS FE,	outside	...	...	...	...	1073
SILVIO	Silvus	...	...	...	...	1078
OSORINI	Of. Sorilli	...	...	...	...	1087
TITVRI·M	...	...	...	...	...	1134
TITVRONIS	...	...	...	...	...	1131
TITVLLVS FE	...	...	...	...	...
TEBPI	Teththi or Tessi (Gaulish)	...	...	...	...
VETERI M...	...	...	...	...	...
VIDVCOS F...	...	...	...	...	...	1178
VORANO	Voranio	...	...	...	...	1219
VRILI ...	...	...	...	...	...	1183
OF. L·C VIRIL,	Officina Luci Cosi Virilis	...	...	...	...	656
A PALM BRANCH	...	...	...	...	...

OWNERS' NAMES AND MARKS SCRATCHED ON THE
OUTSIDE OF SIMILAR VESSELS:—

Will /t/s Melissa?

VMAR

N I I

Trident, O and X

WARRINGTON'S ROMAN REMAINS.

- (2) INSCRIPTIONS AND NAMES OF POTTERS WRITTEN WITH THE STYLUS OR STAMPED IN THE MOULD BETWEEN OR BENEATH THE ORNAMENTS ON EMBOSSED SAMIAN:—

C.I.L.



reversed, Drusus F

1337

(In the possession of Dr. Sherratt.)



reversed, *Paternus* 56

Fac-similes of these two specimens sent to M. Jos. Dehelette, of the Municipal Museum, Roanne, France, for inclusion in his forthcoming illustrated work descriptive of this kind of pottery, have enabled him to identify them as having been made by potters of Lezoux, of the second century.

The written signature of Drusus is also on a fragment of similar pottery recently found at Lancaster. C.I.L. 1337

ACT
ERGIC
EE

Though the exploits of Hercules are represented frequently on Samian, there is no record of any other specimen with a descriptive label of this kind. See fig. 15, p. 79.

- (3) POTTERS' NAMES STAMPED ON THE
HANDLES OF AMPHORÆ:—

C.I.L.

(1331) Vol. VII.

*Potters' Names stamped on the Handles of Amphoræ—
continued.*

	C.I.L.
L . A . L	
LICI SPEC, Lieini Speculae	
III MIN ICIOR	Trinum Miniciorum ...
P . C . I	
Q P P HRY	Q . P. Phryxi
QSASER	Q . Saserna 106

- (4) MARKS, NAMES, ETC., SCRATCHED ON THE
OUTSIDE OF SIMILAR VESSELS:—

V V in letters more than three inches in length, as if done with blunt stick or the back of the little finger nail on the soft clay. Similar letters were found on a tile at Melandra Castle.

▷ **I N S I B A J I** (Densibali), in letters two or three inches in length.

IV<VN S (Jucuns).

ΤΙΛΙΤΙΚ (undecipherable).

Z VIII TR 1 (undecipherable).

Gλυ^να (probably signifying the content of the vessel, 102 lagenæ, *vide Life of the Greeks and Romans*, Guhl and Koner, p. 459).

LXIIIS (= LXIIISemis). On body. This was submitted to Prof. Dr. Böhn, of Berlin, editor of the Gaulish and Germanic *Amphoræ Stilo Inscriptæ*, for vol. xiii. of the *Corpus Inscrip. Latin.* and considered by him to signify the weight of the empty vessel, 63½ ounces.

IVCVNDI, Jucundus.

VII (A number scratched across the lip). Such are quite common.

VIITITRI. Vetteri?

WARRINGTON'S ROMAN REMAINS.

(5) POTTERS' NAMES STAMPED ON THE RIMS
OF MORTARS.

AN[IA]Q	twice. Mameao?
ARB . . .	
BINVS	Albinus?
BR[IC]OS	twice, reversed. Brieos.
BR[UC]I	reversed. Bruci
B R C	
. . . ICO	
BRO	
CEM	
CIV	
CREN	
DOCILIS	
DEC	
ERV CANS.	reversed
EVERIL	
EME . .	reversed
EVIAIF	
GRATIA	
GENIALL.	Genialis?
I[A]O[SI]	reversed. Icotasi or Ieolasi?

*Potters' Names stamped on the Rims of Mortars —
continued.*

ICO

VITTA E reversed, C. Attius Marinus
fecit
NIRAM Found also at Isca (Caer-
leon-on-Usk). *Archæo.
Cambrensis* iii. 1856. p.
77. tab. 2. fig. 4; and

Isca, p. 42 tab. 23, fig. 1.

A[R]NVS Marinus?

NOC

PATINIS or PATINVIS

PRI

SAIL

VRANS

(6) NAME SCRATCHED ON PERFORATED SOFT
RED WARE BEFORE BAKING :—

VITALVS. VΛ Vitalis?

(7) LETTERS STAMPED ON A TILE OR
BRICK :—

XXD (Legio Vicesima Devensis?)

See illustration beneath.



XV.

TEMPLE OR SHRINE OF MINERVA.—On the east side of the Via (and new street named Roman-road), Stockton Heath, partly opposite to the solid foundations described in part XIII., the scanty and puzzling remains were explored of what may have been part of a temple or sacellum of Minerva, seeing that they were associated with the stone head of a goddess, and a palladium or bust of Minerva in bronze.

The foundations of a wall, with facing stones of roughly-hewn ashlar in two or three regular courses, laid on loose sand and gravel without any bottoming (except that the stones of the lowest course were rather larger than those above), commenced at 310 feet from the Ship Canal fence and extended 40 feet 6 inches in line with, and at a uniform distance of 3 feet from the Via. This solitary example of regular masoury was from 2 feet 6 inches to 3 feet wide, and from a foot to 1 foot 6 inches in height, at from 1 to 2 feet below the existing grass level. The carved stone forming part of a cornice with a fillet and cyma recta on one side (referred to in part IV.) was used as a header with the carving hidden at the south end of the wall; and 6 feet beyond this at 4 feet from the Via stood a door-socket, apparently in position, of hard stone (14 by $10\frac{1}{2}$ by 6 inches), the pivot-hole (diameter 2 inches, depth $1\frac{1}{2}$ to 2 inches) sharply cut round the base by the iron pivot ring. (See Plan II., Group III.)

In rear of this end of the wall and door-way, 4 to 6 feet back and 2 feet 5 inches below the grass, was a floor of stiff clay 3 inches thick, and 21 feet 6 inches from north to south by 14 to 17 feet, having on its surface—

(a) A square pavement of amphora shards, each side 7 feet, with a nether quern-stone in position;

(b) An oval hearth of calcined clay, diameters 9 feet by 8 feet;

(c) A heaped-up horseshoe-shaped platform of clay.

These were situated on its N.E., S.E., and S.W. corners respectively.

PUBLIC ALTAR OR FLOOR OF SACELLUM.—Commencing 2 feet further eastward from the floor, and extending a total distance of 30 feet from east to west were—

(a) An oblong platform of calcined and reddened clay, set round and partly paved with squared kerb-stones, 16 feet from east to west by 5 feet 6 inches, and only 1 foot below grass level;

(b) (c) Two extensions paved with rubble, each 7 feet from east to west by 2 feet 6 inches, on opposite sides of its two ends and sloping slightly downwards from the platform;

(d) A smaller platform of stiff clay, 8 inches thick, and roughly square, each side 4 feet 6 inches, placed in front of the south-west corner of the large platform at 2 feet 4 inches lower depth, like a base for a flight of steps.

(The carved stone head of a goddess to be presently described and also a quantity of wood ash were found in slight depressions on the surface of the opposite, N.W. and N.E. corners of the larger platform.)

At a distance of 4 feet north from the latter, at its east end, was a roughly L-shaped floor of hard-burnt clay, partly paved with amphora shards and set round with squared kerb-stones; dimensions: long arm, 8 feet from north to south by 5 feet 6 inches; short arm, 2 feet 8 inches by 3 feet 6 inches; and beyond this, 2 feet further northwards, a circular hearth of clay, hardened by burning, diameter 5 feet 4 inches.

The course of what appeared to be a water-channel or drain, 3 to 6 feet wide, and rounded, with a lining of clay increasing to 6 inches thick along the bottom, was traced for a distance of 37 feet in a N.N.E. direction. It commenced beneath the larger floor of those just described, and increased in depth from 5 to 6 feet northwards, in the direction of the fall of the ground. A short branch, 7 feet in length, and 2 feet 6 inches wide, struck off in a N.W. direction about the middle, and at the junction of the two arms there was a patch of rough

WARRINGTON'S ROMAN REMAINS.

rubble pitching, each side 2 feet 9 inches, to prevent the soil from being washed away or trampled into the ditch.

These rude structures have been somewhat minutely described owing to the interest they derive from the peculiar character of the objects found in their vicinity, among which are the following:—

BRONZE.—Palladium or diminutive bust of Minerva in cast bronze, height 1½ inch, with part of a projecting stud or rivet on the back, by which it was affixed, apparently, to a metal plate. Half the height of the figure consists of a helmet and lofty serrated crest descending to the lower part of the neck. Both sides of the helmet are ornamented with incised spirals terminating in punctures, and on the baldric, which descends from the right shoulder, are three incised rings. The hair escaping from the helmet in curls nearly surrounds the face. The nose is too short and the lower part of the face too long for perfect symmetry; the lips are slightly apart; the eyeballs pierced just below the upper lids to make them appear looking upwards; and the features have a somewhat infantile expression. (See illustration, No. 2, p. 67.)

Smooth flat disc (phalera) diameter 2 1-3 inches, with one end of a projecting loop for a leather strap, ¾-inch wide, on the back, and a hole whence the other end of the loop was torn.

IRON.—Dagger or knife-blade, length 4½ inches, pointed, and curved on both edges, greatest width 1½ inch.

Spiked hook, for insertion in a wall, length 6 inches.

Key, stem perforated, length 4½ inches, lever 1½ inch, two bits ½-inch.

Stilus or moulder's chisel, length 4½ inches, pointed at one end and spatular at the other.

Screw-plate with lever handles (one broken), each 3½ inches in length; plate roughly hexagonal, 1 inch sides, and perforated with 5-16-inch hole for cutting thread (?).

Many nails, length 2 to 5 inches.

Two dozen hob-nails, length ½ to ¾-inch, coated with a thick concretion of sand and rust.

Four strips of leather (?) studded with hob-nails similarly encrusted.

LEAD.—Several pieces of folded sheet lead and lumps run abroad.

GLASS.—Two distorted melon-shaped ribbed beads of greyish vitreous paste slightly coloured with blue glaze and unworn, diameters 9-16 and ½-inch, bore ¼-inch respectively, found on the northmost clay hearth 3 feet from the modern ground level.

Similar bead coated with dark blue glaze and worn round the string-hole, diameter 1 inch.

Three fragments of large square bottles of bluish-green glass, measuring ½ to ¾-inch thick.

Fragment of hollow-sided vessel of dark amber glass.

POTTERY.—Besides the usual fragments of common pottery, there was a larger proportion of Samian, one of the latter stamped with a palm branch in lieu of the name of the potter; and a fragment of soft red local ware with a rude representation of a galloping animal scratched with straight lines and dots previous to baking.

VARIOUS.—Two whole sandstone roofing flags, hexagonal, and many fragments.

Hone or rubbing-stone of fine grey grit, worn on the sides and edges by use (3½ by 1¾ by 1¼ inch).

Nether quernstone of hard grit, slightly conical (broken), diameter 1 foot 5½ inches, thickness 2½ to 3½ inches, hole 3 inches diameter.

Another squared with a hammer for paving, and three fragments.

Several fragments of vesicular lava querns much corroded.

Four lumps of iron ore, 15 of slag, five of mineral coal (probably derived from the adjoining iron smelting and bead making furnaces).

Of special interest is a polished flint celt of Cissbury type, cream-coloured, sharp-edged, and well-proportioned, length 4½ inches, extreme width 1½ inch, thickness ½-inch, found on the west side of the L-shaped clay floor last described, at 2 feet below the grass and 1 foot 6 inches directly over a fragment of smoke-tinted Upchurch ware in the Roman stratum.

XVI.

HEAD OF A GODDESS.—The carved stone head above referred to is 4 inches high, and is evidently an ideal head broken from the statuette of some goddess, which, when complete, was about 2 feet 2 inches high. The workmanship is wonderfully smooth and perfect considering the coarse texture and

softness of the local red sandstone in which it is cut. Though it is nearly in the round there are tool marks at the back where it was not intended to be visible, and lower down it retains a broken portion of the niche to which it was probably attached like the similar figure of Minerva cut in a rock near Chester, and that



1—OWL FACE ($\frac{1}{2}$).
2—BRONZE BUST OF MINERVA ($\frac{1}{2}$).
3—STONE HEAD OF GODDESS (CIRC. $\frac{1}{2}$).

WARRINGTON'S ROMAN REMAINS.

of Brigantia at Birrens (Proc. Soc. Antiq. of Scotland, vol. XXXI., p. 133, 1896). The head is well proportioned, with a fine profile, and mild, dignified expression. An angular band encircles it above the ears, resembling that on the statuettes of goddesses in terra cotta figured in C. Roach Smith's Roman London, p. 109, and more like a conventional representation of a diadem, or nimbus, than a mode of hair dressing. (See illustration, No. 3, p. 67.)

Certain à priori reasons point to the conclusion that the goddess Minerva had a temple in this Roman town recently uncovered on the south bank of the Mersey. In the exhaustive treatise of the late T. Glazebrook Rylands, F.S.A., &c., "Ptolemy Elucidated" and in his papers and maps contributed to the Transactions of the Hist. Soc. of Lancashire and Cheshire, vol. XXX and XXXI, the estuary of the Mersey has been clearly shown to be the Esturia Belisama of Ptolemy's "Geography" written previously to A.D. 161. Two dedications to Minerva Belisama are recorded by Orelli, vol. I. Inscriptionum Latinarum Selectarum, Nos. 1431 and 1969, as having been found in the country of the Convenæ in Aquitaine (Gallia Transalpina) at the head waters of the Garonne (Garumna), a tribe who are supposed to have been river worshippers and followers of the goddess Coventina, whose thirteen altars, and an altar to Minerva, have been found in the well at Procolitia on the Wall of Hadrian in Northumberland.

Minerva was a virgin goddess, the third of the great Capitoline deities, next to Jupiter and Juno, to whom the attributes of the Greek Pallas Athene were transferred by the Romans. She was always dressed and wore a helmet, *egis* (goat skin) fastened with a gorgoneion (Gorgon's head) or shield bearing the same emblem, and coat of armour. The objects sacred to her were the owl, the cock, the serpent, and the olive tree, and her sacrifices consisted of calves which had not borne the yoke (*Vitulus*)—the bull and cow being sacred to Jupiter and Juno respectively. The palladium was the owl-faced image or idol of Athene Ilias, sent down by Zeus to Ilus, which rendered the city founded by the latter, Ilium (Troy), impregnable, and more than 500 of these rude images and many owl-headed vases supposed to be consecrated to

her were found by Schlieman during his excavations on the site. Several towns in which her worship was established subsequently, Athens, Rome, Argos, Lavinium, &c., claimed to possess the true palladium, a name which was at length applied to any image of the goddess.

It may be noticed that the name of the animal sacrificed to Minerva by the Romans—*Vitulus* (a calf)—is similar in sound to the name **VITALVS** scratched on the fragment of pottery mentioned in part XIII. (though spelled with A in the middle instead of U), and that the vessel itself was perforated. Was it portion of a censer (*turibulum*)?

Another fragment of locally made pottery mentioned in the same place, bearing the owl-face is another indication that the worship of Minerva was practised on the spot now being considered, being found on the opposite side of the Via.

As the goddess of wisdom and patroness of all the arts and trades, members of every handicraft and profession were among her worshippers in Roman times,—altars and temples were dedicated to her by their colleges, particularly in the seaport and commercial towns on the west side of Britain. The members of the colleges had a common worship, sacrifices, lares, genii, curia, and insignia, and they sometimes met at the sepulchres of departed brethren to worship, deposit wreaths, &c. The colleges were, therefore, the precursors of the guilds and benefit societies of the present day. At Wilderspool and Stockton Heath the principal college was that of the *fabri ferrarii* or smiths, and the palladium, or little bronze image of Minerva was possibly a portion of one of their badges.

1. An inscription records that a temple to Neptune and Minerva was erected under the authority of a native King *Cogidubnus*, imperial legate, by the college of artificers (*COLLEGIVM FABRORVM*) at Chichester (Regnum) in Sussex.

2. A magnificent temple and six altars dedicated to the Celtic goddess, Sul-Minerva, and bronze and stone heads of images, have been found at Bath, the *Aque Sulis*, or hot springs referred to by the Roman author Solinus (*Solyni. Polyhist. c. 22*).

WARRINGTON'S ROMAN REMAINS.

3. Another inscription mentioned by Wright (Celt, Roman and Saxon, pa. 320) records the restoration of a temple dedicated to Minerva at Ribchester (Bremetennacum); and W. Thompson Watkin (Roman Lancashire, pa. 151) figures and describes a bronze bust of Minerva, with Gorgon's head, fastened to a circular disc $3\frac{1}{4}$ inches in diameter, found there, which must have had a similar purpose to that found at Stockton Heath.

Altars dedicated to her have been found in the following localities:—

4. At Chester, erected by Furius Fortunatus; also a statue of her with the owl, cut in the solid rock on the south side of the river Dee, by the road side after it crosses the river, described by Stukeley, Pennant, and W. Thompson Watkin (Roman Chester, pa. 198);

5. At Birrens (Blatum Bulgium) in Dumfries-shire, by the Second Cohort of the Tungrians (Proc. Soc. Antiq. of Scotland, vol. XXXI. 1896, p. 153);

6. At Carrawburgh (Procolitia) in Northumberland, the 7th station on the Wall of Hadrian, by Venico, found in the famous well along with 13 altars to Coventina and an immense number of coins and other votive offerings;

7. At High Rochester (Bremenium) on the Watling Street, 22 miles north of the Wall, (a) one altar to MINERVAE ET GENIO COLLEGI by Caecilius Optatus, (b) one to Minerva by Julius Carantus, (c) another by Flavius Severinus;

8. At Ebchester (Vindomora), in the county of Durham;

9. At Kirkhaugh (Alione) near Whitley



ROMAN ALTAR FOUND AT WILDERSPOOL.

WARRINGTON'S ROMAN REMAINS.

Castle, to MINERVAE ET HERCVLI VICTORI
(Minerva and Hercules the Victor);

10. At Auchindavy, near Kirkintilloch, the 5th station on the Antonine Wall, to Mars, Minerva, and others, by M. Cocceius Firmus.

11. At Caerleon-on-Usk in South Wales a stone with the gorgoneion (Gorgon's Head) one of the emblems of Minerva; and on another stone, believed to be a cippus, the name Belisimus and a curious dedication to Fortune and Good Luck FORTVN.E ET BONOEVENTO.

The inscription on the only altar yet found upon the site, appears to have been carefully obliterated, the face being quite smooth and angular, while the sides retain the original tool markings, and the remaining surface is rounded by weathering. This obliteration may have taken place after the edict of Theodosius for the extermination of pagan superstition in A.D. 386, about which time, as indicated by the coins found in her well, the shrine of the water-nymph Coventina was destroyed.

The local altar referred to was discovered in 1896, at a depth of about 6 feet from the surface, 30 feet west from the Via and a few feet north from fence between Messrs. Greenall, Whitley and Co.'s brewery field and the Ship Canal bank at Wavertree. It is roughly carved in soft local red sandstone and sub-divided into three

well proportioned members, (a) cornice, (b) shaft or die, (c) pedestal.

(a) The cornice projects on three sides and is ornamented with three half-round mouldings across the front only, the upper one being bevelled off at the ends to suggest a gable or pediment, length 12 $\frac{1}{2}$ in., breadth 8 $\frac{1}{2}$ in., height 5 $\frac{1}{2}$ in.;

(b) The trunk or die is rectangular; length 11in., breadth 8 $\frac{1}{2}$ in., height 9 $\frac{1}{4}$ in.;

(c) The pedestal (podium) is merely a set-off or enlargement on three sides; length 14in., breadth 10 $\frac{1}{2}$ in., height 6in.

Total height 20 $\frac{1}{2}$ inches.

The back of the stone is undressed as if for setting up against a wall.

The only emblems remaining upon it are—(1) the focus for the burnt offering, a roughly incised ring, diam. 3 $\frac{1}{2}$ in., upon the middle of the rear portion of the summit.

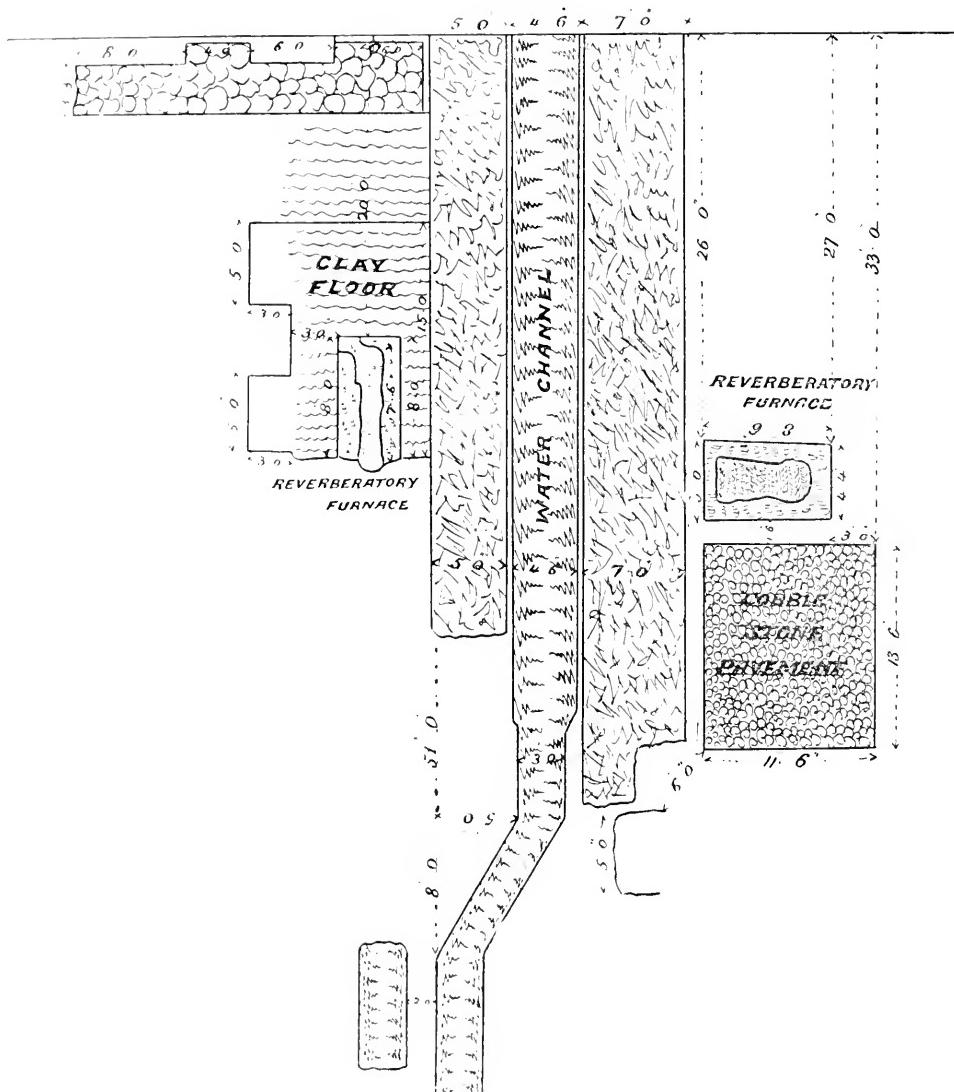
(2) The pulvini or cushions on which the offering was laid, represented by two round bosses on the front corners slightly carved with spiral grooves;

(3) The ureens or ewer, to hold the wine for libations, in high relief on the right side of the shaft.

This altar is now in the Museum at Warrington. (See illustration on p. 69.)

PLAN III.

VIA.



BRONZE-FOUNDERS' AND ENAMELLERS' WORKSHOPS, AT WILDERSPOOL.

XVII.

JEWELLERS' WORKSHOPS.—The remains of jewellers' workshops (bronze founder's, enameller's, &c.) uncovered on the north side of the oppidum and Wilderspool brewery field presented the usual features of a central court-yard, encircled by floors, furnaces and rubbish-pits. The court-yard was an oblong, 13 feet 6 inches from north to south by 11 feet 6 inches, paved with large cobble-stones, closely set on a 6-inch layer of stiff clay, situated at 46 feet west from the lawn fence of Wilderspool House, 33 feet south from the east Via, and 1 foot 6 inches below the grass. Adjoining it on the north side was the clay platform, measuring 8 feet 6 inches from east to west, by 5 feet, which enclosed a furnace cavity resembling a deep boot print, the heel portion being a sort of pit, 1 foot 6 inches deep and wide, with a boss projecting 4 inches from the bottom, round which the crucibles were set, to keep them in position, the fire seat widening to about double, and sloping up to the top of the platform at the opposite end. It was originally overarched and the body of flame was thus concentrated and driven downwards on to the surface of the metal in the crucibles and air excluded. The crucibles themselves, as will be seen later, were about the size of an ordinary coffee cup.

The ash-blackened layer containing Roman remains was of considerable depth all round the furnace, but extended over a wider area and to a greater depth, and included lumps of slag, scoriae, iron nails, potshards, &c., on the south side of the court-yard, as if the refuse had been swept or carried to that side, in the rear of the workshop.

The ground was not fully explored on the east side of the latter, but a rude pitching of sandstone rubble, 10 feet square, was uncovered at 18 feet from its south-east angle and 2 feet 6 inches below the grass.

A peculiar feature was a water-course or leat along its west side, about 3 to 4 feet 6 inches wide at the surface of the undisturbed sand, and 5 feet 6 inches in depth below the existing

surface, or about half that depth originally, which was traced for 160 feet, in nearly a direct line north and south, with only a slight bend at 51 feet from the Via, and served for conveying water to the adjoining workshops from the higher ground to the south, or possibly also as a drain discharging towards the adjoining river.

To prevent the soft sand-bank on either side from being trampled into the water-channel there was a rude pitching of sandstone rubble, 5 to 7 feet wide, on the Roman surface, and extending 50 feet along its east side and 39 feet along its west side southwards from the Via.

Several interesting objects—silver coins of Trajan, Hadrian and Aelius, portions of an upright sided embossed Samian bowl, and plain cups and dishes, nearly complete, a water-bottle, wanting the handle, but otherwise unbroken, and an urn of black Upchurch, quite perfect, were obtained from the black clay and mud along the bottom of this ditch; and bits of bronze, a chasing chisel, broken fibulae, fermail, stud, &c., in bronze and enamel (to be presently described), fragments of glass, coloured enamel paste, or frit, &c., and portions of crucibles with bronze adhering inside from among the loose stones of the pitching and ash blackened debris adjoining the court-yard.

The remains of another workshop were uncovered along the west side of the rubble pitching bordering the ditch, and in the rear of the foundation of a wall (probably that of a shop or dwelling), having a frontage of 24 feet along the edge of the Via, and 3 feet to 3 feet 6 inches in width. It was evidently a building of some importance, as the facing stones were in regular courses, hammer-dressed, or split and tapered towards the inside of the wall in the Roman manner, and there were two shallow projections (1 foot by 6 feet and 4 feet respectively) for supporting a door sill or portico in front, as in the houses of Silchester (Calleva), &c. Seven feet south from the foundation there was a hard clay floor, measuring 23 feet from

WARRINGTON'S ROMAN REMAINS.

north to south, by 9 feet, and 3 inches thick, with two roughly paved extensions on the west side measuring 5 feet by 3 feet in the same directions; and, on the surface of the former, a long reverberatory furnaee of special interest, and worthy of detailed description owing to its completeness. The enclosing platform was 8 feet by 4 feet, and, though the covering had collapsed, the broken fragments filled up the whole of the cavity, but thereto were billets of burnt wood or unspent charcoal between the two layers of calcined clay in the neck of the fire-hole, which was supported with stone jambs. The stoke-hole was 2 feet 6 inches in length, and widened outwards from 1 foot to 2 feet 6 inches, the burnt clay hearth in front being, as usual, carefully laid on cobbles. The width of the furnace cavity also increased gradually to 1 foot 8 inches at the rear, where it was provided with an opening 8 to 10 inches wide on one side for charging and discharging. The total length of the cavity was 7 feet 6 inches. Its depth likewise increased from 4 inches at the back of the fire-place to 7 inches and 6 inches at either end, forming a sort of bridge in the middle, and so constructed as to concentrate the heat on to the surface of the material with which the furnace was charged.

The associated finds have greatly enriched the Museum, and left no uncertainty as to the occupation of the Roman inhabitants, but can only be briefly referred to owing to their number.

COINS.—In addition to the three silver denarii, above mentioned, a first bronze of Trajan, a second bronze of Nerva, and three second bronze coins too much corroded for recognition.

BRONZE.—Bow-shaped fibula, with short cross-bar (broken and corroded);

Harp-shaped fibula, length $2\frac{1}{4}$ inches, with collar-moulding on middle of bow, coiled spring and part of pin;

Fibula, length $1\frac{3}{4}$ inch, flat lozenge-shaped body decorated with central disc of glossy black and band of pale greenish corroded enamel, slender cross-bar with part of pin, and head of animal with two eyes, one of which retains a small red gem forming an eyeball;

Bow-shaped fibula, length $1\frac{1}{2}$ inch, with dog-tooth ornament, and stud with wheel-cross on summit;

Penannular ring brooch, diameter $1\frac{1}{8}$ inch

(broken), with one moulded end and loop hinge of pin;

Fermor or button, diameter $\frac{3}{4}$ -inch, decorated central disc of faded yellow enamel, and encircling band of cable pattern, opaque white and pale green alternating (partly corroded);

Stud (two thin discs, diameters $\frac{3}{8}$ and $9\frac{1}{16}$ inch, united by a short bar, diameter $1\frac{1}{8}$ inch), the lower plate plain, the upper one decorated on the surface with enamel of most delicate workmanship—a square of bright red, with arms of an expanding Celtic cross on each side in minute chequers (8 squares to $\frac{1}{4}$ -inch), white and bright green alternating, and the triangles between the arms of the cross filled with pure white. Unfortunately, the retaining band of bronze round the edge is partly corroded;

Head of pin in form of a round boss, and encircling rim (east hollow);

Small three-lobed ornament (solid);

Altar-shaped handle or staple, length $2\frac{3}{4}$ inches, with half-round mouldings at plinth and cornice, square shaft, and cylindrical loop, diameter $7\frac{1}{10}$ inch, with ornamental stud on summit, a shank or tang at opposite end broken;

Two plain rings of equal size (1 inch outside, $\frac{3}{4}$ -inch inside diameter), one smoothed and polished, the other retaining the fin, or rough seam from the cracks of the mould on both sides, showing it was cast on the same spot and left unfinished;

Strip (chasing chisel?), dimensions $2\frac{3}{4}$ by $\frac{1}{4}$ by $1\frac{1}{10}$ inch;

Portion of rim of patera, with edge slightly thickened, and two incuse lines by way of ornament on the outside;

Small billet, length 1 inch, nipped by pincers at both ends;

Odd bits of plate, wire, and drops of the same metal.

IRON.—Triangular three-bladed and barbed arrow-head, length $2\frac{1}{8}$ inches, with slender pointed tang, length $\frac{1}{2}$ -inch, for insertion in the shaft, found along with several corroded iron pellets and a burnt clay sling-ball (described in part IV.) in the bottom of the water-course between the two workshops. Though found in Southern Europe and in Egypt of the same shape in bronze (Memoirs of the Egyptian Exploration fund, Tammis, part IV., plate xxxix, fig. 20), the only iron one previously recorded

WARRINGTON'S ROMAN REMAINS.

in Britain is that figured (but not described) in Dr. Bruce's Roman Wall, ed. 1851, plate xviii., fig. 1, although several have recently been discovered at Barr Hill, on the Antonine Wall, along with others of still more peculiar shape—a circular loop, about an inch long and wide, formed by three steel wires welded together at both ends into two sharp spikes, one to form a point, and the other a tang for insertion in the shaft. This was a convenient shape for quickly inserting a wisp of burning tow to form the ferventia jacula mentioned by Cæsar, *De Bello Gallico*, V., 43;

Stylus, length $5\frac{3}{8}$ inches, pointed at one end and spatular at the other, probably used as a moulder's chisel;

Key, length 3 inches, with web bent at right angles, length $1\frac{1}{2}$ inches, and two bits, length $\frac{3}{8}$ -inch;

Various other iron objects, such as hook, staple, hasp, ring, strip with loops at each end, and several dozen iron nails, 2 to 5 inches in length.

LEAD.—Harp-shaped fibula, length $1\frac{5}{8}$ inch, with collar moulding round middle of bow and terminal knob, no pin;

Weight, flat disc shaped, diameter $2\frac{1}{4}$ inches, weight 8,065 grains, or rather more than 19 Roman unciae, which averages 8,000 grains;

Several pieces of rod, strip and sheet lead, and lumps run abroad.

GLASS.—The glass specimens are specially interesting, as indications of the kind of industry carried on in the adjoining workshops.

Three amorphous lumps of coloured enamel or frit, in parts coated with white silica like a flint nodule, and in parts fractured, showing the surface of glass-paste in different shades, viz., turquoise blue, pale greenish, and brownish tinted, the former resembling in colour that of the glaze on the ribbed beads found near the same spot (see below);

Angular fragment of cobalt blue, translucent glass mass, partly altered on the surface to a brownish tinge by decay;

Small angular fragment of black, glossy, unaltered enamel or frit like obsidian. (This is the most durable kind of enamel on brooches as well as in the mass);

Three melon-shaped ribbed beads of greyish vitreous paste, coated lightly with blue glaze,

diameters $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$ -inch respectively. (These are slightly distorted, unworn by rubbing round the string-hole, and probably "wasters" from a workshop near at hand);

Fragments (five) of flat window glass of various shades, greenish blue to bluish green, owing to impurity, fire-polished on one side, and dull on the other from contact with the stone mould;

Portions of the rims of vases of clear glass (two), the bodies small and globular, and the original width across the rim about $2\frac{1}{2}$ inches.

Small bits (two) of pure glass, crystallinum, with raised ornamental cordons, solidly moulded on one, hollow blown on the other;

Lower portion of handle of a jug or ewer, of dull pea-green colour with three slight folds by way of ornament;

Miscellaneous fragments of square bottles and globular vessels of greenish and bluish tinted impure glass.

POTTERY.—The whole and nearly whole vessels from the mud in the bottom of the water-course have been already referred to. The fragments of Castor ware and of coarser descriptions, urns and flat dishes of black and grey Upchurch; jars, pans, dishes, mortars of local red Veratine ware, and amphoræ were exceptionally numerous.

MISCELLANEOUS OBJECTS.—The purpose for which the east-most furnace, adjoining the cobble pavement, was employed is shown by the discovery underneath the surrounding platform and in the black lining of the adjoining water-channel of five fragments of crucibles coated on the inside with corroded bronze and some other greyish metal (tin or zinc). One fragment was $\frac{3}{8}$ -inch thick, and large enough to indicate that the crucible was originally cup-shaped, about $2\frac{3}{4}$ inches across the rim and $1\frac{3}{4}$ inch deep. The metal adhering to another of the fragments was analysed by Mr. Ruddock, whose certificate states the following particulars:—

Copper oxide.....	43.65	= Metallic copper	34.85
Tin oxide	4.89	= , tin	3.82
Zinc oxide	0.75	= , zinc	0.60
Insoluble residue	41.31		
Iron oxide, alkalis, &c.	9.40		
		100.	

WARRINGTON'S ROMAN REMAINS.

"These proportions would give a bronze of the composition, copper 88.74, tin 9.73, and zinc 1.53 per cent."

It is, therefore, a specimen of the brass (orichalcum), of which the sestertii, or first bronze coins of the Higher Empire, and probably also the fibulae and other such articles found near at hand, were composed, which was reckoned at double the value of the ordinary red bronze, containing about 90 per cent. of copper and 10 of tin, with no zinc. The metal zinc was unknown to the Romans, but was added in the form of carbonate (calamine), which is named *cadmia* by Pliny, *Nat. Hist.*, xxxiv., 10, "lapis ex quo fit as *cadmia* vocatur."

A lump of vesicular scum or sandiver from the same spot, analysed by Mr. Ruddock, was found to contain:—

Alumina.....	4.22
Lime and magnesia.....	0.35
Insoluble residue (silicate of alumina, with a little lime and magnesia and 4.43 of alkalis)	95.02
—	—
	99.59

and was deemed by him on account of its purity to be waste from enamel or glass making.

Lumps of haematite, reddle, clayband iron ore and slag were scattered here and there in the bottom of the ditch and underneath the stone pitching round about the workshops, but were probably derived from the iron smelting furnaces closely adjoining, on the west side, described in part VI. Four samples of slag were analysed by Mr. Ruddock, to determine whether copper was smelted from the ore in this locality, or brought there in a metallic state. The results were:—

	1.	2.	3.	4.
Ferrous oxide	29.75...	53.65...	63.15...	17.00
Ferric oxide.....	23.31...	10.03...	8.56...	4.32
Alumina	2.27...	1.97...	2.15...	.60
Lime and magnesia ...	2.72...	1.65...	1.40...	—
Phosphoric acid .....	.30...	.73...	.43...	.64
Moisture and inorganic matter	1.90...	1.30...	1.50...	—
Insoluble residue (silicate of alumina).....	39.72...	27.95...	21.20...	80.42
—	—	—	—	—
	99.97...	97.28...	98.39...	99.98

They are certified to be iron furnace slags with no trace of copper or copper smelting.

Low down in the bottom of the water-channel, beside one of the largest fragments of bronze crucible, there were five large pieces of cannel and one of ordinary mineral coal, the position of which was carefully noted to afford satisfactory evidence of its use as fuel by the Romans. This has now been sufficiently established by the evidence of competent authorities in twelve different localities, *viz.*:—

At Manchester (Mancunium) a large buried store was found close to the issue of the Roman road from the eastern gate. (Whitaker's *Hist.*, p. 80, and Röder's *Roman Manchester*, pp. 151, 159.)

At Chester (Deva) in excavations near the gas works Mr. Shrubsole found fragments, chiefly cannel of good quality, associated with Roman remains. (Jl. Arch. and Hist. Soc., N.S. vol. I, p. 77.)

At Bath (Aqueæ Sulis) it is referred to by Solinus as being employed to maintain perpetual fires in the Temple of Minerva, about the 3rd century, A.D. "In cuius Æde perpetui ignes nunquam canescunt in favillas, sed ubi ignis tabuit, vertit in globos saxeos," Solini Polyhist., c. 22. (Mon. Brit. Hist.)

At Wroxeter (Uronicum) "coal, in its mineral as well as in its burnt condition, was found lying adjacent to and within some of the hypocausts." (Wright's *Uronicum*, pp. 55, 115, 159; Jl. Brit. Arch. Assoc., vol. 16, p. 34.)

At Caerwent (Venta Silurum), Monmouthshire, "there was evidence in many places of the use of coal in Roman times, and numerous small cubes, probably from the Forest of Dean coal field, were found in several of the Roman houses." (A. T. Martin, M.A., F.S.A., and Alfred E. Hudd, F.S.A., *Archæologia*, vol. LVII.)

In several stations per lineam Valli its discovery has been recorded:—At Housesteads (Borborevicius) excavated in 1883 nearly a cart load was found in the guard chamber of the southern section of the east gateway. (Dr. Bruce's *Guide to the Roman Wall*, ed. 1863, p. 119.)

At Cærvoran (Magna), in digging up some of the foundations in 1762, coal cinders, some very

WARRINGTON'S ROMAN REMAINS.

large, were turned up. (Wallis, *Hist. of Northumberland*, vol. I, p. 119.)

In excavating the Mucklebank wall turret during 1891 a piece of coal was found under circumstances which showed that the Romans must have worked some of the outercapping seams of coal not uncommon in the district. (*Arch. Æliana*, vol. XXIV., p.16.)

At Great Cheaters (Esica) a small quantity was found. (*Ibid*, p. 48.)

According to Dr. Bruce: "In several places the source whence the mineral coal was procured can be pointed out." (*Roman Wall*, 2nd ed., p. 433.)

In the Roman villas at Great Witcombe, "several large pieces of pit coal were found." (*Archæologia*, vol. XIX., p. 183.)

At Spoonley Villa, near the Roman coal mine, in the Forest of Dean, it appeared to have been used to heat the hypocaust furnaces. (Prof. J. H. Middleton, F.S.A., *Archæologia*, vol. LII, part 2, p. 651.)

In his account of the Roman buildings at Woodchester, p. 12, Lysons states that a considerable quantity of coal ashes was discovered.

At South Shields "a quantity of coal has been noticed in the station; it usually lies deep down, so that it cannot have been placed there after the departure of the Romans." (*Archæologia*, vol. XLVI, p. 170.)

From these rude structures it may be inferred that the mechanical arts among the provincial Romans were conducted on a scale which could be included in an ordinary dwelling and its adjoining back-yard, by "little masters," who were artists or experts, with perhaps a learner, and one or two slaves, as assistants. Much light has been thrown upon the subject by the description, recently published,* of an industrial settlement of the second century discovered in the province of Namur, Belgium, known as the Villa d'Anthee, founded by Anteius, Procurator Metallorum of Tiberius, A.D. 14 to 39. The villa, which covered nearly 60 acres and overlooked the iron mines, is stated to have been vast and beautiful, inside the walled enclosure of which there were

dwellings for the work people, stables, cattle-sheds, barns, &c., of timber and "wattle and daub," raised on basements of stone and surrounded by corridors and sheds. There were altogether nineteen groups of industries, mechanical and agricultural, such as forge, furnaces for working iron, artistic bronze and enamel, kiln for coarse pottery, harness shops, and workshops for leather, and brewey on the right of the enclosure, the furnaces for founding being set up a few yards from the dwellings under sheds for fear of fire.

The rest of the description reads very much like an account of the local discoveries at Winderpool and Stockton Heath.

The first of the two industrial groups was to the right of the enclosure, after passing through the owner's dwelling, and was for the manufacture of bronze objects and enamelling. The fragments of crucibles were recovered, some retaining residues of bronze, and others of enamels of various shades, especially red and green of soft faded aspect, the former produced by red cupric oxide and a little oxide of iron, and the latter by green cupric oxide without iron, in lead glass, with added stannic oxide, and niello or black glass, produced by adding lead and sulphur.

Among the tools employed were delicate little enameller's tongs, a very fine pair of compasses in bronze, saws, files, a soldering tool, iron ladles of different sizes, the scales of a balance, leaden weights, sharpening and polishing stones, ornaments for caskets and furniture in bronze, busts of Diana and Mercury, the latter 4 $\frac{3}{4}$ inches high, of a style and technical perfection in advance of the North of Gaul, possibly imported to serve as a god of commerce to adorn the walls of the workshop.

The next group of buildings served chiefly as a blacksmith's shop, and leading to it from the Roman way which ran round the encircling wall of the villa there was a stone causeway by which mineral and charcoal were conveyed to the furnace. The latter consisted of a cavity 15 $\frac{3}{4}$ inches (40cm.) wide, excavated in the soil; the walls, unfortunately very much destroyed, were formed of stones and cubical bricks, coated with refractory clay, with an air opening in the base, much broken down, but recognizable as a reverberatory furnace.

* *Annales de la Société Archéologique de Namur*, 1902, 24 vol., 3me livraison, p. 238, A. Bequet, *La Bijouterie chez les Belges, &c.*, II. Siècle.

WARRINGTON'S ROMAN REMAINS.

Other remains were a furnace for smelting and refining purposes, and there were residues and slags of copper, tongs, ladles shovels, and poker.

The earliest type of ornament belonged to the transition period between Gaulish and Roman, known as late Celtic, as at Wilderspool. (See fig. 2, p. 79.)

In this region, between the Sambre and Meuse it is stated, there are a great number of "bas fourneaux," and enormous heaps of iron-

slag, known as "crayats de Sarrazins," which like those found in Sussex, have furnished abundance of material very rich in iron for modern smelters.

It is curious to note that "Saracen's Head" is the name of an inn close to the site of the oppidum at Wilderspool, and that this was the name formerly given to the Roman coins so commonly found there—a circumstance which has no doubt given rise to the name of the inn.

WARRINGTON'S ROMAN REMAINS.



WARRINGTON'S ROMAN REMAINS.

XVIII.

The principal structures uncovered and objects associated with them collected during six seasons of systematic excavation (1898-1903) having now been described, it only remains to mention briefly some of the more important finds not yet specified, and to draw a few general conclusions from the investigation.

LIST OF OBJECTS.

In addition to the following, there are a number of small, broken and corroded specimens, such as rings, fragments of mirrors, iron knives, keys, styls, clamps, earthenware spindle whorls, &c., not separately described.

BRONZE.

FOOT-RULE.—A bronze regula or pes lay directly underneath one of the large facing stones of the rampart near to the north-west angle. It is made to fold in halves by means of a five-plate hinge, and, to prevent it from bending in use, is provided with a hinged latch or stay (now broken) on one limb to slip under the heads of two studs on the other. Inches are marked on one side by slight indentations, with a double mark for a quarter foot. Owing to the corroded state of the metal it has been kept folded, and its length estimated by adding that of the two halves together, the sum being 11.54 inches, or about one-tenth less than the normal Roman foot, which is 11.6496 inches. The only other specimen of British provenance, found at Caerleon-on-Usk, is described in the Archaeological Journal, vol. VIII., p. 160, and figured in the catalogue of Mr. John Edward Lee, F.S.A., p. 69, plate XXXV., No. II. (See fig. 11, p. 79.)

AMULET OR LOCKET.—This fine example of the art of enamelling, or decorating metal objects by fusing patterns in coloured glass upon their surface, is of special interest, as a survival of a phase of native British civilization, known as Late Celtic, which was prior to the Roman occupation. It consists of two thin plates of bronze, lozenge shaped, each side $\frac{3}{4}$ -inch long,

with edges turned at right angles, so that when conjoined they form a locket or satchet for containing scents or amulets. The back plate is perforated with four holes at the angles, but is otherwise plain. The front plate has been cast with 25 compartments, and these have been filled with enamel, forming a trellis pattern, or diamond lattice, which, when fresh and perfect, must have been both pleasing and effective. One corner has been destroyed by corrosion, and the enamel has, through age or chemical action, faded to a uniform pale green colour. (See fig. 1, p. 79.)

A like specimen previously discovered at Wielderspool, but not deposited in the Warrington Museum, is figured in the "Journal of the Architectural, Archaeological, and Historical Society of Chester," parts x. and xi., 1876, p. 211, and described by Dr. Kendrick thus: "No. 6 in our plate of illustrations is a lozenge-shaped object in bronze, with the remains of a hinged pin at the back, probably another variety of the fibula. Its form at least appears complete, the small compartments in its front still retain the blue and yellow enamel, with which they were all no doubt originally filled." Nothing is known of the whereabouts of this valuable specimen.

BISTOURY.—An instrument identical in shape with the surgeon's scalpel of the present day. It has a two-edged leaf-shaped handle, 2 inches long by $\frac{1}{2}$ -inch wide, with a rectangular hilt, 1 inch long, of bronze, in one piece. The haft retains part of an iron blade, ingeniously dovetailed into it for about $\frac{3}{4}$ -inch, though the external portion of the iron is almost entirely corroded away. There are deep narrow grooves at the extremity of the haft for receiving a binding wire, by which the attachment of the handle was apparently completed. (See fig. 10, p. 79.)

FIBULA.—A nearly perfect bronze fibula, length $\frac{1}{2}$ inch, shaped like the sole of a sandal, filled with blue enamel, having four yellow spots, and only the ring for attachment of the chain partly corroded. (See fig. 3, p. 79.)

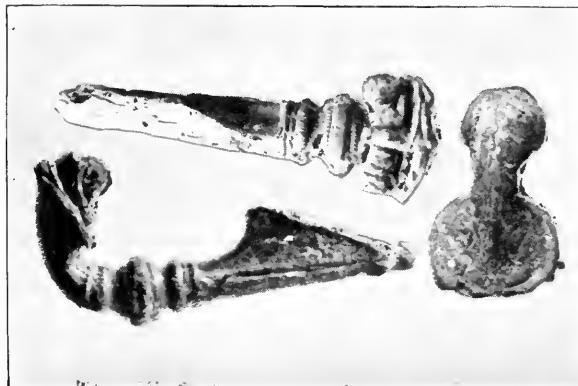
WARRINGTON'S ROMAN REMAINS.

HARP-SHAPED FIBULA, richly ornamented over the entire surface; a massive trumpeted head, with incuse spirals enclosing triangles; the middle of the bow with a collar-moulding of half-round plain and beaded cordon and grooves; and a moulded foot with traces of black enamel on the front. The spiral spring of the pin is complete with five coils of wire on one side of the central retaining loop, and three coils on the other. Length, $3\frac{1}{2}$ inches. A fibula of similar shape, but plain surface, in gold, discovered at Ribchester (Bremetennacum), and preserved in the Blackburn Museum, is considered by Mr. Arthur J. Evans, M.A., F.S.A., to belong to the second century of our era.

tation in relief on one side, and plain on the other. It is pierced at one end with a round hole, and at the other with an oblong slot. (See fig. 2, p. 79.)

CIRCULAR FLAT BROOCH, seven-eighths of an inch in diameter, with central boss and six surrounding studs arranged hexagonally, encircled by a slightly raised rim, much corroded; the intervening surface filled with black enamel, still hard and glossy. On the back there are slight traces of the hinge and catch for the acus.

FIBULA, of greyish bronze or other non-corrodable alloy, two inches in length, shaped like an animal's hind leg; the paw divided into five claws by radiating grooves; the hip or widest



HARP-SHAPED FIBULA (THREE VIEWS).

LIGULA.—A diminutive long-handled bronze spoon, the bowl narrow and pointed, length $\frac{3}{4}$ -inch, width $\frac{3}{8}$ -inch, with a tang and rivet for fastening it to the handle, which is bulbous at the top, twisted or torquated in the middle, and ornamented with incised rings at intervals. Length, $6\frac{1}{4}$ inches. The tubular brass case (theca) for containing it was found therewith in a corroded and damaged condition. It resembles a probe (specillum), also contained in a bronze box, discovered in the surgeon's house of the Strada Consolare at Pompeii. See fig. 12, p. 79.

BRONZE HASP, $1\frac{7}{8}$ inches in length, with characteristic Late Celtic trumpet-shaped ornamen-

portion hollow and five-eighths of an inch in width. The acus and its attachments are wanting.

HEART-SHAPED ORNAMENT OF A HAIR-PIN, with a small portion of the pin attached. A central wheel-cross in front had the quadrants between the arms of the cross inlaid with an opalescent pale grey enamel, of which slight traces are visible.

BOLT OF LOCK, with three slots, dimensions $2\frac{1}{4}$ by 4-10 by 1-10 inch. (Identified by Mr. H. L. Grueter, F.S.A., of the British Museum.)

BANGLE OR ARMLET of plain bronze wire, about $\frac{1}{8}$ -inch thick, broken at the joint, but with both

WARRINGTON'S ROMAN REMAINS.

ends tongued to overlap and pierced with rivet-holes, one rivet remaining, and no larger than the head of the smallest pin in present use.

LEAD.

LAMP STAND, cut and hammered out of sheet lead about $\frac{1}{8}$ of an inch thick, in one piece originally, consists of a flat circular dish, $3\frac{3}{4}$ inches in diameter, with nearly upright sides, $\frac{1}{4}$ of an inch in height; a semi-circular spout projecting about an inch on one side of the rim, and on the opposite side a loop handle, formed by a folded strip, about an inch wide, terminating in a crescent-shaped holder, which

most probable suggestion as to its use is that it was the oil receptacle for some kind of lamp, or a drinking cup for a birdeage.

STONE.

A large stone (24 by 20 inches, and 6 inches thick) with a rectangular mortise or groove (12 by 8 inches and 2 inches deep) on one surface, and with one end bevelled so as to leave the mortise open on that side, was found on the west side of the fortified enclosure, and was supposed at the time to be the base of a large wooden pillar. In the light of subsequent discoveries it appears to be in reality a mould for making window glass. The number and variety in shade and thickness of the fragments found in its vicinity leave no room for doubting that window glass was made there.

Another large stone (20 by 13 by $9\frac{1}{2}$ inches), having a splay on two sides of one of its ends, forming a sort of pedestal to give it a firm basis, was probably a hypocaust pillar (*pila*).

HAND-MILL OR QUERN.—In addition to numerous fragments of upper stones and a few conical nether ones unbroken, a complete pair of hand-mill stones of coarse grit, 15 inches in diameter, has recently been obtained from Stockton Heath. The upper stone is from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches thick, and concave beneath to fit on to the surface of the lower stone, which is conical, and from 2 inches round the edge to $3\frac{3}{4}$ inches thick in the centre. An iron pivot about $\frac{1}{2}$ -inch thick, fastened in the centre of the lower stone, projects through a hole $1\frac{1}{2}$ inch in diameter in the upper stone, on the top of which there are opposite grooves, $2\frac{1}{2}$ inches in length and $1\frac{1}{2}$ by $\frac{3}{4}$ -inch in width and depth, for an iron cross-bar having a central hole for the pivot. Funnel-shaped channels are cut in the stone between these two grooves, into which the grain for grinding was poured, and on one side a slot for insertion of a wooden handle is provided.

ANIMAL REMAINS.

Decayed teeth of horses and oxen and bits of burnt bone were met with throughout the excavations, but only in one spot were animal remains obtained in any quantity, where they lay directly underneath the clay covering of an oblong rubbish-pit, situated on the outside edge



HAND LAMP (LUCERNA) OF COMMON RED WARE AND LEADEN HOLDER.

spreads directly over the middle of the dish. It was used for supporting one of the small terra-cotta hand-lamps (*lucerna*) so common in all Roman sites, and evidently served the three-fold purpose of raising the lamp above the table, preventing it from being upset, and catching any oil dripping from the wick or spilling when it was carried about. The owner's mark, IV., is scratched on the inside.

PEWTER CUP.—This curious vessel was found at 28 inches below the ordinary surface and 10 inches below a burnt vegetable layer in the middle of a trench on the west side of the Via, at Wilderspool. At the back it is flat and quite plain for setting up against the wall, but in front is nearly semi-circular and moulded in a graceful ogee curve. It stands $2\frac{1}{2}$ inches high, and measures at the rim $2\frac{5}{8}$ inches across the back or chord, and 2 inches across the radius at right angles. The corresponding dimensions of the base are $1\frac{1}{2}$ inches by 1 inch. The inside contours show that it was cast in a mould. The

WARRINGTON'S ROMAN REMAINS.

of the west ditch, at 50 yards from Greenall's avenue. The pit was evidently constructed in two parts, one section measuring 9 feet from north to south, by 6 feet, and the other 7 feet by 8 feet in the same directions, the original depth being from 2 feet 6 inches to 3 feet, underneath about an equal depth of surface soil. The bottom of both was dished and overlaid with 4 to 5 inches of well puddled brown clay to prevent contamination of the soil by infiltration of sewage, and a drain, 11 inches wide and deep, also lined with clay, from the north-west angle of the earlier section, passed underneath the adjoining section, and extended 12 feet westward, where it discharged into a larger channel, 1 foot 3 inches wide, running north and south. The covering was an 8-inch layer of very hard yellow clay, partly paved with sandstone slabs, and partly burned on the top to harden it, which had sunk 6 inches in the middle owing to the decay or drying up of the contents. These were ash-blackened and of the most varied description:—(1) A first bronze coin of Hadrian and two corroded second bronze coins undecipherable; (2) oval brooch in green and white enamel, bronze pin and needle, a hollow sheath, wire and strip bronze; (3) iron wedge, soldering bolt, loop, clamps, &c., and several large nails; (4) scraps of sheet lead; (5) thirty different kinds of glass fragments, including flat window, square bottle, globular bodied vases of greenish tinted and pure crystalline glass, several in a crackled or dragaded condition, and lumps of sandiver or scum from the melting pots, produced during the manufacture; (6) potshards of Samian, Durobrevian or Caistor ware, and ordinary unglazed black, grey

and red pottery; (7) lumps of slag and reddle, a single fragment of pink mortar (*opus signinum*), a stone whorl or glass-cutter's wheel, &c. The animal remains were kindly examined by Professor Boyd Dawkins, F.S.A., and found by him to include:

- (1) Portions of the upper and lower jaws and single teeth of oxen (*Bos longifrons*);
- (2) Upper molars of horse (*Equis caballus*);
- (3) Portions of the upper and lower jaws, tusks, incisors and cusps of molars of pig (*Sus scrofa*);
- (4) Tibia and part of lower jaw of sheep or goat.

These were all of domestic varieties.

COINS.

The complete list of recorded coins as found upon the site now includes:

Consular or family denarii	3
Vespasian	6
Domitian	6
Trajan	29
Hadrian	17
Lucius Ælius	1
Antoninus Pius	2
Marcus Aurelius	2
Commodus	2
Faustina	1
Lucius Verus	1
Lucilla	1
Septimius Severus	1
Constantine the Great	2
Corroded and undecipherable	15
Total	89
	—

WARRINGTON'S ROMAN REMAINS.

XIX.

GENERAL CONCLUSIONS.—In the unfortunate absence of all inscriptions except potters' stamps, speculation as to the dates of the rise and fall of the Roman settlement can have no definite result. But these dates may be approximately inferred from the account given by Tacitus (*Annales*, cap. XII., 32, and *Agricola*, cap. XVIII, et seq.) of the conquest of this portion of Britain, and from the accumulation of evidence from coins, pigs of lead, and other inscriptions found at Chester (*Deva*), Manchester (*Mancunium*), Wigan (*Coccium*), Ribchester (*Bremetennacum*) and Condiate, stations mentioned in the Antonine itineraries, which are near at hand, and in their rise and fall must have been more or less contemporaneous.

Familiarity with the surroundings makes it possible to recognize the natural advantages for which the site was chosen. It stands at the head of the tidal portion of the estuary of the Mersey, where the river first becomes fordable at low water, and on high ground, 41 feet above ordnance datum, outside the great loop of the channel opposite the town of Warrington. Thus it overlooks a wide stretch of the south Lancashire plain, and is above the reach of the frequent floods which formerly converted the flat marshy river bed, about a mile wide, lying between the fortification and the old ford at Latchford and Warrington parish church on the opposite side into a bottomless quagmire. Being on the direct line of an army advancing northwards along the west side of the island, the fortification was necessary for commanding the ford and affording a refuge for troops and travellers “waiting for a ford,” which arrived only twice in the twenty-four hours (for which purpose Wilderspool Spittal was subsequently provided), and it has remained the principal crossing for the great western highways and railway lines, and point of dispute between contending armies ever since. It was also a suitable station for a portitor or collector of tolls and customs after the Roman method of

raising a revenue, and a convenient port for flat bottomed trading vessels arriving from the west and exporting locally made pottery, iron, glass, jewellery, baskets, and salt from the neighbouring Salinae, situated at Northwich, only eight miles south from Wilderspool on the direct Roman highway. Though no trace of a permanent bridge has yet been discovered on the line of the Via, which has been traced northwards through Wigan to the river Clyde, it is quite possible that the single-log dug-out canoe, of unusually skilful construction, which was uncovered during the excavation of the Walton Lock, a little lower down the river, and now in the Museum, may have formed part of a pontoon bridge or bridge of boats, such as accompanied the Roman legions in carts. (See *Trans. of the Historic Society of Lancashire and Cheshire*, vol. 12, 1896, p. 9.) The slight eminence named Hill Cliffe, on the south side of the fortification, was probably the landmark used by the Romans in laying out the straight lines of the military highway running north and south. The gravelly and sandy character of the sub-soil rendered the site a dry and perfectly salubrious one, and it possessed an easily accessible supply of pure water at a depth of about 10 feet, in the wells, three of which have been cleared out, and found to be steined and well pugged with stiff clay to prevent surface infiltration, the water being collected and retained by thin layers of greyish loam intercalated with other beds forming the middle sands and gravels of the drift.

Even without the indication of the one significant inscription—a broken tile, with the incomplete stamp XXD (Legio Vicesima Devensis?)—it might have been inferred that the original fortification was erected and garrisoned by a cohort or ala of the 20th Legion from the neighbouring headquarter camp at Chester (*Deva* leg. XX. vict.). The same legion was no doubt actively employed in A.D. 48

WARRINGTON'S ROMAN REMAINS.

under P. Ostorius, when he returned from an expedition against the Decangi in North Wales, to quell a rising of the Brigantes, whose territory extended from sea to sea northwards from the Humber and Mersey, and when he probably erected forts to secure his then existing frontier (*ne nova moliretur nisi prioribus firmatis*, *Annales XII.*, 32). The legion was also in the locality in A.D. 71, when, by war or subjugation, a large portion of the Brigantes was absorbed under Petilius Cerialis (*Agricola*, c. 17); and again in A.D. 80, under the great general, Agricola, with his expedition against the Brigantes and the more northern tribes, which ended in the occupation of Scotland as far as the Forth and Clyde, when the road along the west coast so often referred to was probably constructed. The construction of the fort may, however, have been deferred until the fifth year of Agricola's government, A.D. 82, when he lined the coast of Britain opposite Ireland with garrisons (*eamque partem Britanniae quaē Hiberniam aspicit copiis instruxit*, *Agricola*, c. 24).

The early arrival of the Romans in this portion of Britain is amply confirmed by epigraphical evidence. Pigs of lead with Roman inscriptions (1) EXKIAN of Nero's fourth consulship, A.D. 59, found at Stockbridge, Hants; (2) DECEANGI of Vespasian's third consulship, A.D. 74, found near Chester, and (3) no fewer than twenty pigs of Vespasian, Domitian, &c., A.D. 76 to 96, one with DECEANC, found at Runcorn, proving that lead mines in North Wales were worked by the Romans, and that landing places and roads leading from them were in existence at those dates. (W. Gowland, F.S.A., F.I.C., *Archæologia*, vol. LVII.)

The recent discovery of leaden pipes of Vespasian's eighth consulate, A.D. 79, with the name of Agricola as imperial legate at Chester, shows that at that date it was a flourishing town with a public water supply. (Chester Archaeological Soc. Jl., vol. VIII., p. 87.) A hoard of British coins lately found at Honley, near Huddersfield, including those of Cartimandua or Cartimandua, queen of the Brigantes down to A.D. 69, is concluded to have been deposited after, but not long after, A.D. 72 or 73 (G. F. Hill, M.A., *Numis Chron.*, vol. XVIII., 1897, p.

297), which is probably the date of the first Roman occupation of their territory.

An approximate date for the final destruction of the Roman town near Warrington may be similarly inferred, and although no coins of later date than Constantine the Great, A.D. 306-337 have been obtained, this may be due to the small size and complete corrosion of later ones owing to their nearness to the surface, nearly all the coins recovered being in bad condition on that account. The latest coins found at Wigan (Coccium) are of Tetriens, circa A.D. 273; at Ribchester (Bremetennacum), of Valens, A.D. 334; at Manchester (Mancunium), of Valentian, A.D. 364; at Wroxeter (Uronicum), of Gratian, A.D. 383; at Chester (Deva), of Magnus Maximus, A.D. 383-7; at Lancaster (Rigodunum?) of Honorius, A.D. 395; and in the four last-mentioned localities a number of small barbarous minimi in use after the Roman departure—prove their continued existence down to the fifth century of our era. No adequate grounds exist for assigning an earlier date for the destruction of the Wilderspool station than for any of these surrounding stations.

In the "Saxon Chronicle," under the year A.D. 607, we read that Ethelfrith, the Saxon King of Northumbria, "led his army to Chester, and slew numberless Welshmen," and as his descent was from the east and north, it is probable that Wilderspool fortifications were destroyed on his way to or from the former, and in the same year, A.D. 607.

The names of this and the adjoining townships, Stockton Heath, and Walton Superior and Inferior, indicate the existence of the fortifications down to Saxon times. Indeed the whole facies of the discoveries—structures, pottery, manufactures, &c.—suggest an early and long continued occupation.

All the underground walls were "polygonal," i.e., of the later Mycænean, as distinguished from the earlier Cyclopean style of masonry, the latter consisting of large polygonal blocks, with closely fitted joints, but without regular courses or any kind of mortar; the former always retaining cavities filled in with small stones and consolidated with clay, with a tendency to regular courses. According to Mr. F. Haverfield,

WARRINGTON'S ROMAN REMAINS.

F.S.A., the ramparts at Gelligaer, near Cardiff, and at Aldchester, near Oxford, are similarly constructed to those at Wilderspool, viz., rough stone facings with an earthy core between, and earthen ramparts seem to have been commonest in the first century A.D.

In this connection the following additional examples of the use by the Romans of clay as a building material are interesting:—

The Roman walls of Manchester (Maneunium) are stated by the Rev. J. Whitaker (*History of Manchester*) to have "had a foundation of paving stones (boulders) bedded in clay."

The walls of the casta at Lancaster, according to W. Thompson Watkin (*Roman Lancashire*), bear the precise character of those found at Manchester—"blue clay under the foundation being always found."

In describing the excavations at Wroxeter, Wright (*Urcionium*, p. 97) says that the wall "consisted merely of large cobble stones (or small boulders) and broken stones from the quarry, which had been placed together without any order, and imbedded in clay" . . . The external fossa or ditch was likewise faced on both sides with a mass of clay.

The late Mr. Charles Potter, describing the remains of ancient dwellings exposed at Great Meols, on the coast of the Wirral peninsula (*Trans. Hist. Soc. Lanc. and Ches.*, vol. XXVIII, p. 139), says:—"The floors are made of puddled clay," and "what remains of the walls, which in one varied from 9 to 15in. in height, shows that they were made of wood frame-work, filled in with puddled clay similar to the floor, the puddle being worked to a smooth surface. The perpendicular timbers of the frame-work were supported on long irregularly squared blocks of sandstone, two of which had holes cut into their surface for the foot of the timber to rest in." The Roman coins, catalogued by Dr. Hume (*Ancient Meols*, p. 290) as being found in this locality, extend from Claudius (A.D. 41-54) to Magnus Maximus (A.D. 383-8).

Similar remains at Filey, on the opposite coast of Britain, are thus described by Professor Phillips of Oxford (*Annual Report of the Yorks. Philo. Soc.* for 1857):—"Four-squared stones set in clay with which boulders had been

mixed had stood at the corners of a rectangular space, probably supporting angle-posts and horizontal tie beams, on which a roof of straw or turf had been placed." The floor above the clay and boulders was a thin irregular layer of concrete, on which lay a mass of rubbish, bones, and charred oak, with coins of Constantius and Constantine in considerable numbers—"all Roman, without intermixture of any work of later generations." He concluded that it had been used "as a shelter for a detachment of Roman soldiers appointed to guard the coast."

Dr. Bruce, describing the construction of the great wall of Hadrian between the Tyne and Solway, (*Roman Wall*, p. 90), says:—"At Sewing Shields the entire foundation has for some distance been laid upon a bed of clay three or four inches thick"; and in a footnote on p. 91:—"In some parts of the line the joints of the wall are at present filled with earthy matter instead of mortar, and it is the opinion of some authorities—and amongst them the eminent architect and intelligent antiquary, Mr. Dobson of Newcastle-upon-Tyne—that in these places clay has been originally substituted for mortar."

During the excavations at Birrens (*Blatum Belgium*) in 1895 by the Scottish Society of Antiquaries (*Proceedings*, 1895-6, p. 118), it was found that "for the lowest course of stones, and mostly the second also (of the interior buildings), or what of the wall would be lower than the surface of the ground, instead of lime mortar, clay is used for bedding and jointing. The work is exceedingly good, every crevice closed, and the whole a solid mass. . . . After the lapse of so many years these footings, so built, where undisturbed by force, are yet in perfect order, whereas the lime mortar used in the over-walling has been wholly absorbed by the accumulated soil. These methods of constructing the foundations and footings are peculiar to the primary walls."

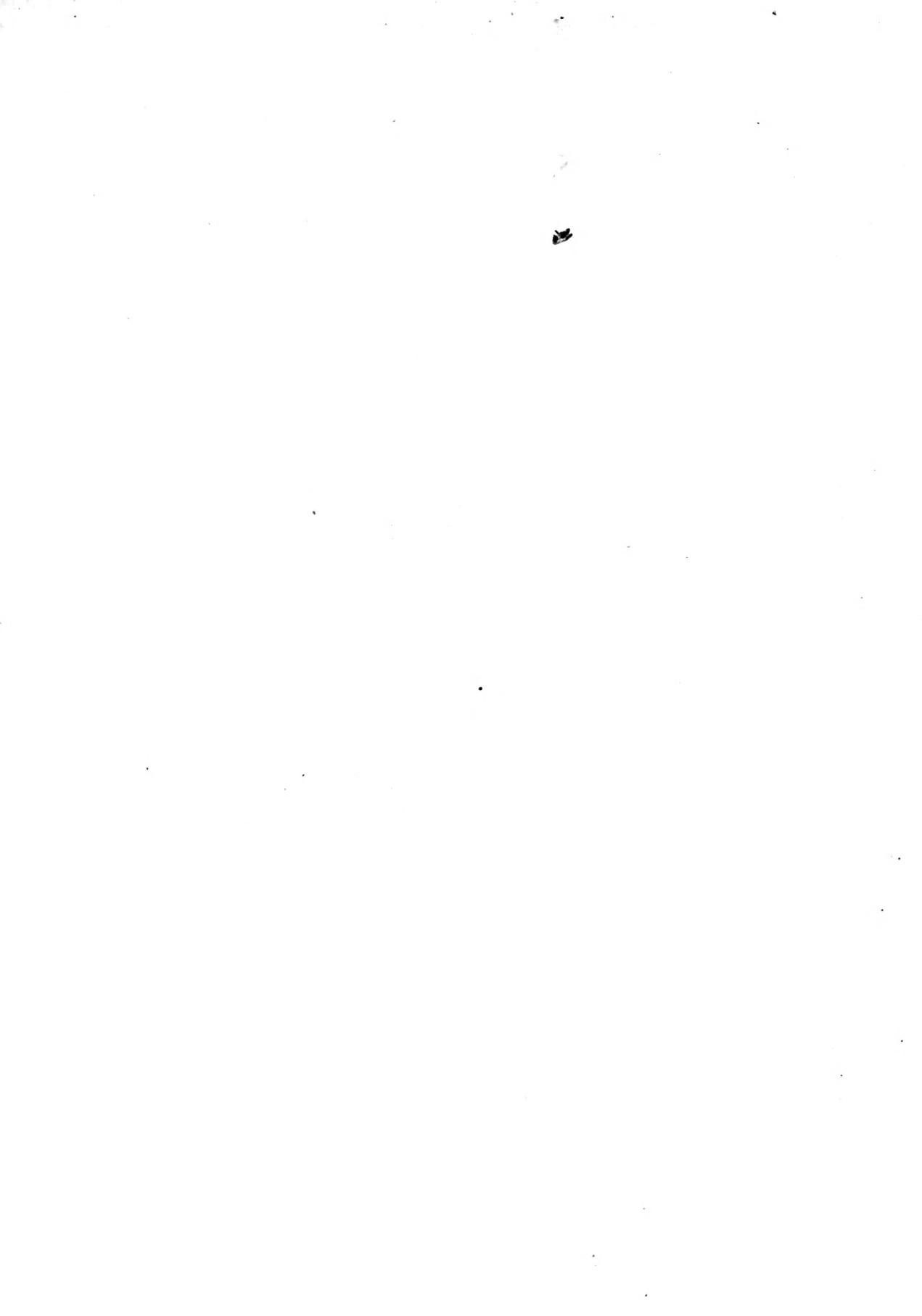
Since neither the sand forming the site at Wilderspool, nor the heathy sod upon its surface, were adapted for constructing an earthen rampart, and there is no lime in the vicinity for making mortar, it was inevitable that the

WARRINGTON'S ROMAN REMAINS.

abundant boulder and alluvial clay and red sandstone rock close at hand should be utilized in the fortification.

Renewed thanks are finally due to Messrs. Greenall, Whitley and Co., for permission freely accorded to carry on the excavations in their

home paddock and to deposit the "finds" in the Museum, and especially to Mr. T. J. Down for constant support and sympathy; and also to Messrs. C. W. Davenport, W. Boothroyd and J. Hallows for similar permission over less extensive areas.





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